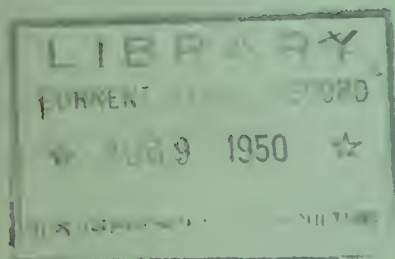


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ANNOTATED
BIBLIOGRAPHY
ON
SEDIMENTATION



Compiled under the auspices of
Subcommittee on Sedimentation
Federal Inter-Agency
River Basin Committee

Prepared under the supervision
of the Soil Conservation Service
U. S. Department of Agriculture

ANNOTATED BIBLIOGRAPHY ON SEDIMENTATION

Prepared under the supervision of the
SOIL CONSERVATION SERVICE, DEPARTMENT OF AGRICULTURE
cooperating with the following agencies represented on the
Subcommittee on Sedimentation
Federal Inter-Agency River Basin Committee

DEPARTMENT OF AGRICULTURE
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ANNOTATED BIBLIOGRAPHY ON SEDIMENTATION

FOREWORD

This bibliography has been compiled as a guide to the literature on the engineering aspects of sedimentation. Every effort has been made to cover all of the known sources of information in the English language. To make the bibliography of maximum usefulness each reference has been annotated and indexed with respect to subject matter and geographical location.

Work on this bibliography was started in May 1938 as a WPA sedimentation literature research project sponsored by the Soil Conservation Service. Headquarters for the work were established in New York City. Working space for project personnel was provided through the courtesy of the Engineering Societies Library, New York Public Library, Columbia University Library, New York Municipal Library and New York Botanical Garden Library all in New York City. The project was operated until July 1942, when the facilities and personnel were made available to the Military Intelligence Division of the Office of Chief of Engineers for strategic engineering studies. Coverage of literature published up to 1942 was nearly complete when the sedimentation literature research was discontinued. Annotations, extracts and other bibliographical data prepared on this project were sent to the offices of the Soil Conservation Service in Washington, D. C., for safekeeping when the activities of the project were directed to the war effort.

A report of the status of the sedimentation literature research project was presented to the Subcommittee on Sedimentation, Federal Inter-Agency River Basin Committee, at its 5th meeting in September 1946. Recognizing the need and value of this information in the field of sediment engineering a Work Group was appointed to investigate ways and means of bringing the references up to date and publishing a comprehensive annotated bibliography. Funds for a professional assistant and for editing, typing and publishing the bibliography were supplied by the various agencies represented on the subcommittee on Sedimentation. In order to make the additional bibliographic data in the Soil Conservation Service files generally available the Subcommittee sponsored the microfilming of the entire file of extracts and cross-reference cards. The negatives of these microfilms, consisting of 25 reels, are on file with the Soil Conservation Service, Washington, D. C., and copies may be obtained from them at cost of reproduction.

The annotated bibliography was compiled mainly from a shelf-by-shelf canvas of engineering and geological literature in the principal libraries of New York City. In addition a page-by-page review was made of more than 150 principal English-language proceedings and transactions of the leading engineering societies of the world. In the course of this work nearly 100,000 separate issues of periodicals, books and reports published prior to 1942 were reviewed. A less complete canvas was made of the literature for articles published after 1942. This consisted mainly of a review of the indexes of a limited number of periodicals which the original canvas indicated as being most likely to contain the more important articles on sedimentation. The result is a comprehensive bibliography which is estimated to contain well over 90 percent of the more important articles on sedimentation published in the English language prior to January 1, 1950.

The bibliography also contains references to unpublished theses and translations of foreign-language articles which are not included with annotations in the U. S. Geological Survey bibliography of 1937. ^{1/} Many theses have been written and

^{1/} Williams, Gordon R. and others, Selected Bibliography on Erosion and Silt Movement. U. S. Geological Survey, Water-Supply Paper 797, 91 pp., Washington 1937.

translations of foreign articles made by students of various universities and colleges throughout the United States. Several of the Federal agencies also have prepared translations of foreign articles on sedimentation. No exhaustive effort was made to compile a complete list of these; the references contained in the bibliography represent only the theses and translations contained in the files of the Corps of Engineers, the National Bureau of Standards, and the Soil Conservation Service in Washington, D. C.

Some subjects in the bibliography have been covered more thoroughly than others depending on the availability of the lists of references and bibliographies on these subjects. No attempt has been made to cover allied fields of endeavor which have a bearing on sedimentation such as fluid mechanics and soils analysis, though in some instances several of the more important works in these fields may be included.

Because of the limited funds available to complete and publish the bibliography it was not possible to verify the citations of each article with the original. The citations used are those supplied by the New York sedimentation literature project. It is felt that the few inherent errors which might be found in the citations would hardly warrant the additional time and expense involved to check all of the citations back to the original sources.

Acknowledgements

The bibliography was conceived and compiled under the direction of L. C. Gottschalk, Head, Sedimentation Section, Soil Conservation Service, Washington, D. C. Supervision of the bibliographical work of the WPA sedimentation literature research project in New York was provided by representatives of the Soil Conservation Service, namely, A. C. Stern, Willard M. Porterfield and Sidney Greenberg. The work of bringing the annotations up to date and preparing the index was done by Louis Karhi. Editing, assembling, and typing of the final draft was done by the Library of the United States Department of Agriculture under the supervision of Margaret C. Schindler. The work of these and many others who contributed to this bibliography and the generous cooperation of the New York libraries are gratefully acknowledged.

H. K. Armstrong, Corps of Engineers
F. F. Snyder, Corps of Engineers
V. A. Koelzer, Bureau of Reclamation
M. D. Dubrow, Bureau of Reclamation
Parker D. Trask, Geological Survey
W. W. Hastings, Geological Survey
L. C. Gottschalk, Chairman, Soil
Conservation Service

February 23, 1950

ANNOTATED BIBLIOGRAPHY ON SEDIMENTATION

ABBOT, HENRY L. See also Humphreys, A. A., 1.

1. Alluvial basin of the Mississippi [letter to editor]. *Sci. Amer. Sup.*, vol. 1, no. 14, p. 211, illus., Apr. 1, 1876.

Comments on a review of the report of the U. S. Levee Commission (*Sci. Amer. Sup.*, vol. 1, no. 11, Mar. 11, 1876). The writer discusses the occurrence and character of blue clay in the bed of the Mississippi River in contrast to J. B. Eads' observations and rebukes Eads for his criticism of the report of the Chief of Engineers, U. A. Army, relative to the amount of sediment carried in suspension by the Mississippi. Gives data from Report upon Physics and Hydraulics of the Mississippi (Humphreys, A. A., 1) on the observations at Carrollton on the sediment content of water and the relation between depth and mean velocity and sediment content, taking exception to Eads' remarks on the contraction of the channel below Bonnet Carré crevasse.

2. The physics of the Mississippi River [letter to editor]. *Van Nostrand's Engin. Mag.*, vol. 20, no. 1, pp. 1-6, Jan. 1879.
Exposes some errors in the review (Eads, J. B., 4). In this connection discusses the relation between velocity, suspended matter, and the nature of the bed of the Mississippi.
3. Regulation of rivers in the interests of navigation. *Prof. Mem.*, vol. 1, no. 31, pp. 222-231, July/Sept. 1909.

Lecture delivered at George Washington University Mar. 17, 1909 on river regulation for improvements to navigation. Obstructions to navigation due to conditions of erosion and deposition in streams are noted. Local improvements by dredging, facine-mattress construction, and training works are briefly discussed.

ABBOTT, H. B.

1. Changes in our streams. *Forest Leaves*, vol. 5, no. 1, pp. 9-10, Feb. 1895.

Discusses bank erosion along the Delaware River and filling of channels of tributary creeks in the western part of New Jersey, and cites the washing away of an orchard, a graveyard, and former Fort Elsinboro constructed by the Swedes in 1643. The vicinity of Great Egg Harbor River creeks, formerly navigable for large vessels, are now navigable only for boats of 50 or 75 tons and at unusually high tide.

ABBOTT, HOWARD C.

1. Erosion of water plants. *S. Dak. Acad. Sci. Proc.*, vol. 19, pp. 107-108, Oct. 1, 1939.

Deals with the removal by scour of plants growing in ponds on flood plain of the Missouri and Vermillion Rivers. Notes effect of sediment-laden water in scouring plants as contrasted with clear water.

ABERT, J. W. See U. A. Engineer Dept., 1.

ABORN, R. H.

1. (and Davidson, R. L.). X-ray studies of particle size in silica. *Franklin Inst. Jour.*, vol. 208, no. 1, pp. 59-71, July 1929.

Records the results of an X-ray examination of powdered silica specimens which show the part that size distribution plays in the X-ray pattern; notes the need to know the size distribution before attempting to estimate quantitatively the average particle size from the X-ray pattern. Promising results were shown by microphotometric analysis for a quantitative relationship between characteristics of pattern and average particle size, if size distribution was approximately constant.

ACHESON, EDWARD G.

1. Deflocculation [extract]. *Engin. News*, vol. 66, no. 23, p. 677, Dec. 7, 1911.

An extract from a paper read before the Society of Chemical Industry, London, on laboratory tests to determine the cause of physical differences existing in clay. Notes that residual clays are nonplastic while sedimentary clays are more or less plastic and that this plasticity is developed during transportation by water. Describes experiments in deflocculating clay and graphite with solution of tannin.

ADAMS, C. D. See Rogers, H. S., 1.

ADAMS, CLIFFORD.

1. Modern sedimentation in the Galena River Valley, Illinois and Wisconsin. 34 pp., June 1940. Unpublished thesis (M. S.) - State University of Iowa.

An investigation to determine the volume of modern sediments on flood plains of the Galena River and its tributaries in order to measure soil erosion in the basin and to correlate sedimentation conditions with effects of agricultural land use. The amount of mine wastes in the valley deposits was also studied. Mechanical analyses of sediment were made. Conclusions of the study are given.

2. Accelerated sedimentation in the Galena River Valley, Illinois and Wisconsin. 67 pp., illus., May 1942. Unpublished thesis (Ph. D.) - State University of Iowa.

A study in the Galena River Valley in the Driftless Area of the upper Mississippi River basin of conditions of accelerated sedimentation due to increased erosion. Includes also the study of mine wastes in this area. Determines volume of modern sediment on the flood plain. Profiles show depth and distribution of modern soils on the flood plains in this region.

3. Mine waste as a source of Galena River bed sediment. *Jour. Geol.*, vol. 52, no. 4, pp. 275-282, illus., July 1944.

Notes that comparisons of the carbonate content and texture of mine wastes and stream-bed material show that mining wastes furnish a major part of the stream-bed sediment of the Galena River in southwestern Wisconsin and northwestern Illinois. Mine wastes formed about two-thirds of the stream-bed deposits in the lower two-thirds of the Galena River in the summer of 1941. The coarseness of the mine waste causes it to be deposited in the stream bed and not to form flood plain deposits as readily as the silts and clays.

ADAMS, FRANK D.

1. The embankments of the River Po. *Science*, vol. 3, no. 73, pp. 759-761, May 22, 1896.

Discusses conditions of transportation and deposition of sediment by the Po and other rivers in the plains of Lombardy, Italy. Notes action of the River Po in extending its delta. Discusses conditions of deposition of sediment in stream channels with consequent raising of bed above level of surrounding plain and its effect on flood heights.

ADAMS, K. T.

1. Hydrographic manual. U. S. Coast and Geod. Survey, Spec. Pub. 143, 940 pp., illus., 1942.

A textbook in which are described modern methods of hydrographic surveying and equipment. States the general requirements of the U. S. Coast and Geodetic Survey for the execution of hydrographic surveys. Describes in detail instruments and methods used in echo sounding and radio acoustic ranging.

ADAMS, LEWIS M. See also Curd, W. C., 1.

1. Navigation companies vs. water power users,

Sebago Lake, Maine. Prof. Mem., vol. 4, no. 14, pp. 253-270, illus., Mar./Apr. 1912.

Discusses the controversy between navigation and power companies on Sebago Lake, Maine. Describes regimen of Songo River noting river bank conditions, geologic formations, flood conditions, and instability of channel bed. Points out improvement to mouth of Songo River by addition of simple riprap jetties. Growth of delta in Sebago Lake is at the rate of about 30 ft. per year. The construction of a moveable dam on Lake Sebago is proposed in preference to a fixed dam to flush out accumulation of sediment at each spring flood. Notes that dam would increase backwater from Lake Sebago and cause Songo River to silt up. Suggests bank protection works, dredging in river, and that a low lift lock and moveable dam be built to maintain a navigable depth of waterways and preserve the water supply for power purposes.

ADAMS, R. M.

1. Hogwire for riprapping on irrigation canal embankments [letter to editor]. Engin. News-Rec., vol. 85, no. 8, pp. 374-375, illus., Aug. 19, 1920.

Describes use of hogwire for riprapping irrigation canal embankments at Twin Falls Canal, Idaho. Wire is used over willows, sagebrush or hay to protect banks of main canals and laterals at points of transition of current below structures, on made bank on outside of curves to stop current erosion and where wave action causes sloughing of earth fills. Notes building up of banks by silt deposits resulting from use of hogwire riprapping.

AGAR, WILLIAM M.

1. (and Flint, Richard Foster, and Longwell, Chester R.). Geology from original sources. 527 pp., illus., New York. Henry Holt and Co., 1929.

This is a compilation or collateral reading for students of geology; includes discussions on the flood plains of meandering streams describing those of the Po and the Mississippi Rivers; the Red River rafts; flood conditions and floods of the San Juan and Mississippi Rivers; sediments and sedimentary rocks; and the effect of mankind on rates of sediment transportation and deposition.

AGRICULTURAL EDUCATION ASSOCIATION, SUB-COMMITTEE.

1. The mechanical analysis of soils: A report of the present position and recommendations for a new official method. Jour. Agr. Sci., vol. 16, pp. 123-144, Jan. 1926.

A report of a subcommittee on the mechanical analysis of soils. The subcommittee made various recommendations, such as use of peroxide in the dispersion treatment, use of the pipette method for mechanical analysis, manner of reporting results.

AHMED, ABDEL AZIZ.

1. A method of estimating the maximum possible silt deposit upstream of dams constructed in silt-carrying rivers. Inst. Civ. Engin. Jour., vol. 16, no. 7, pp. 399-403, illus., June 1941; [abstract], Water and Water Engin., vol. 43, no. 545, pp. 288-289, illus., Oct. 1941.

Attempts to provide a solution for the determination of the boundary conditions, which enables an estimation to be made of the maximum quantity of silt that can possibly be deposited in a reservoir under given hydraulic conditions. Data are presented on the maximum amounts of silt-deposit corresponding to given water-levels in the Aswan Reservoir, together with resulting percentage reduction in its capacity.

AIRY, WILFRED. See Shelford, W., 1.

AITKIN, W. W.

1. Management of impounded water in Iowa. North Amer. Wildlife Conf. Trans. n. s. 2, pp. 424-427, 1937.

Deals with the proper management of impounded waters in Iowa for maximum production of fish and for recreational purposes. Considers briefly the problem of siltation con-

trol in reservoirs and notes that 17 reservoirs in Iowa with an average existence of 28 years and with an average capacity of 378 acre-feet, showed an average annual depletion in capacity of 3.17 percent.

ALBANY, N. Y., WATER COMMISSIONERS.

1. Report...transmitting the report of the Superintendent of the water works for the year 1875. 72 pp. Albany, 1876.

Notes causes and conditions of deposition in Tivoli Lakes reservoirs (pp. 8-11).

2. Report...transmitting the reports of the Superintendent of the water works for the year 1877. 59 pp. Albany, 1878.

Notes conditions and causes of deposition in the Tivoli Lakes subsiding reservoir; recommends removal of deposits (pp. 13-14).

ALBERT, FRED C.

1. Silt-eliminating flume for high silt content water. Public Works, vol. 69, no. 6, pp. 15-16, June 1938. Describes a silt-eliminating flume near Columbus, Nebr., and discusses the problem of the disposal of silt of the Loup River.

ALBERTSON, M.

1. Isotatic adjustments on a minor scale in their relation to oil domes. Mining and Metall., vol. 2, no. 170, pp. 38-39, illus., Feb. 1921.

Deals with the drainage of Cobalt Lake, Ontario, Canada, during summer of 1915 by the Mining Corporation of Canada. Describes geology of lake noting that from 1905 to 1915 about 1,500,000 tons of mill tailings were deposited in it from hydraulic mining operations. Outlines physical features of mud on lake bottom, and notes appearance of mud domes when lake level was lowered.

ALEXANDER, LYLE T. See Olmstead, L. B., 1, 2.

ALL-AMERICAN CANAL BOARD.

1. The All-American Canal. 98 pp., illus., Washington, 1920.

A report dealing with the various engineering problems associated with the proposed construction of the All-American Canal. Includes discussion on the silt problem, silt carried by the Colorado River in suspension, estimated bed load, and the necessity for desilting Colorado River waters.

ALLAN, PHILIP F.

1. (and Davis, Cecil N.). Ponds for wildlife. U. S. Dept. Agr. Farmers' Bul. 1879, 46 pp., illus., July 1941.

Describes means of protecting farm and ranch ponds from sedimentation, soil erosion, and water loss through the use of vegetation suitable as food and shelter for wildlife. Gives information on the management of wildlife in farm ponds. Includes discussions on vegetation for pond and pond areas which impedes the flow of silt and vegetation for upland areas which keeps silt out of ponds. Plant groups with high wildlife value useful in pond areas to induce sediment deposition are described.

ALLDIS, V. R.

1. Hydrology in relation to soil erosion. Inst. Engin. Austral. Jour., vol. 11, no. 7, pp. 245-258, illus., July 1939.

An attempt to prove the correlation between hydrology and soil erosion and the essential significance of the former in studies of the latter. Reviews conditions in various parts of the world and suggests the collection of data regarding Australian conditions with a view to checking tendencies likely to lead to soil erosion. Includes discussion on the relationship between "Rain-fall-evaporation ratio" and degree of reservoir siltation and sediment content of streams.

ALLEN, C. R.

1. Protection of river banks at Ottumwa, Iowa. Iowa Civ. Engin. and Surveyors Soc. Proc. 7, pp. 39-46, illus., Jan. 1895.

Conditions of bank erosion on the Des Moines River at Ottumwa, Iowa, and proposed plans for protection of the banks are discussed.

2. Flood relief measures at Ottumwa, Iowa. Iowa Engin. Soc. Proc. 16, pp. 137-144, 1904.

Describes proposed channel straightening and bank protection work to alleviate flood condi-

tions of the Des Moines River at Ottumwa, Iowa Includes brief discussion on results of writer's investigations relative to conditions of bank erosion and the downstream movement of bends in the Des Moines River.

ALLEN, H. S.

1. The motion of a sphere in a viscous fluid. London, Edinb. and Dublin Phil. Mag. and Jour. Sci., (ser. 5), vol. 50, no. 304, pp. 323-338, illus.; no. 306, pp. 519-534, illus., Sept., Nov. 1900.

Confirms experimentally Stokes' formula for the rise of air bubbles in water and aniline and for the fall of solid spheres in these same liquids. Gives Allen's equation for velocity of fall of spheres in the size range closer than that covered by Stokes' law and finer than that covered by Newton's law.

Comments on the photographic method of determining velocities, accelerated motion of the falling sphere, terminal velocity of the falling sphere, fall of an oiled sphere, law of resistance, etc. The object of the experiments was the measurement of the terminal velocity attained by a spherical body falling freely in a viscous fluid. Shows that the law of resistance to the motion of a sphere moving with constant velocity in a viscous fluid depends on the magnitude of that velocity, recognizing three distinct stages.

ALLEN, JACK.

1. An investigation of the stability of bed materials in a stream of water. Inst. Civ. Engin. Jour., no. 5, pp. 1-34., illus., Mar. 1942.

A flume investigation to establish the magnitude of the current velocities which cause movement of regular-shaped blocks in rows which form an embankment or laid in random fashion so as to form a mound, also the corresponding velocities if the work were carried out in flexible bolsters which contain stone chippings. Experiments were also made on flat beds and mounds which were composed of chippings only. Discusses experiments on beds of various materials carried out by the U. S. Waterways Experiment Station, Vicksburg, Miss., and by D. T. L. Chou at Manchester University. Treats of the opponent mechanism of the bed movement in a tidal modal.

ALLEN, PERCIVAL.

1. Correlation between allogenic grade size and allogenic frequency in sediments. Jour. Sedimentary Petrology, vol. 17, no. 1, pp. 3-7, illus., Apr. 1947. Deals with working-hypotheses concerned with the interpretation of allogenic grade size-frequency correlations. These hypotheses are applied to certain petrographical data.

ALLEN, R. E. See Brune, G. M., 1.

ALLEN, VICTOR T.

1. Terminology of medium-grained sediments. Natl. Res. Council, Div. Geol. and Geog., Com. on Sedimentation, Rpt. 1935-36, App. I, Exhibit B, pp. 18-47, Sept. 1938. Notes by P. G. H. Boswell. Treats the classification and terminology of medium-grained sediments. Reviews names of medium-grained sediments and their usage and recommends a list of definitions to restrict and clarify their meaning.
2. Weathering and heavy minerals. Jour. Sedimentary Petrology, vol. 18, no. 1, pp. 38-42, Apr. 1948. Notes that weathering destroys some heavy minerals at their source so they are not represented in the sediments. Weathering concentrates stable minerals so as to increase their proportion in the sediments. Points out that exact information on the variety of hornblende, garnet, or other members of variable groups should be given, because the different varieties do not have the same resistance to weathering. Treats the detrital garnet problem.

ALLING, HAROLD L.

1. A diaphragm method for grain size analysis. Jour. Sedimentary Petrology, vol. 11, no. 1, pp. 28-31, illus., Apr. 1941.

Treats measurement of grain size in terms of nominal sectional diameter; the use of a large diaphragm greatly shortens the time. Describes the apparatus and compares parallel measure-

ments which show that the device can secure accurate grain-size data in a very short time.

ALLIS, JOHN A.

1. How silt is measured on project streams. Soil Conserv., vol. 1, no. 1, pp. 5-6, illus., Aug. 1935. Reports silt measurements on Stillwater Creek and West Fork of Brush Creek at soil erosion project at Stillwater, Okla., and at Council Creek outside of project area. Investigations made at these three stations will give a comparison of stream flow, ground water levels, and silt movement on project area with that of a similar untreated area. Describes station equipment, methods of collection and analysis of silt samples, and methods of determining groundwater fluctuations.

ALLISON, J. C. See also Kelly, W., 1; Rothery, S. L., 4.

1. Maintaining irrigation canals subject to heavy deposits of silt. Engin. Rec., vol. 66, no. 20, pp. 556-557, illus., Nov. 16, 1912.

Refers to the canals of the Colorado River and notes that Imperial intake from this river is cleared of its heavier silt deposit by two suction dredges. Location of dredges and mode of operation are given. Calls attention to silt deposits in distributing canals and describes means for its removal. Describes operation of a new all-steel portable clamshell dredge on the distributing canals of the Imperial canal system and gives cost and effectiveness of clearing canals.

2. Study silt problem in Imperial Valley System.

Engin. Rec., vol. 73, p. 182, illus., Feb. 5, 1916.

Considers the silt problem in the Imperial Valley System. Notes that the proportion of semi-saturated silt to water by volume is dealt with instead of measuring the proportion of dry silt to water in terms of weight. Points out that in 1914, 30,024,000 cu. yd. of solid matter had passed through the Hanlon headgates. Considers the removal of material from canals.

3. Control of the Colorado River as related to the protection of Imperial Valley. Amer. Soc. Civ. Engin., Trans., vol. 81, pp. 297-325, illus., 1917.

Comments on the direct relation of the Colorado River to the maintenance and perfection of levee systems protecting Imperial Valley, Calif. Discusses engineering aspects involved in protecting the valleys from overflow. Describes various cases of excessive erosion and silting in several channels of the Colorado Delta. Cross-sections of the river in the stretch at Yuma and Hanlon Heading are examined and closure of Bee River at Heading is proposed. Distribution of river-bed material, graded as to weight and deposited in direct relation to velocity of water, is noted. Discusses the stability of several levees in the delta area and the possibility of dredging.

Discussion: A. L. SONDEREGGER, pp. 325-333, concurs with Allison's proposal to effect a closure of the Bee River by means of a temporary diversion of the Colorado at Hanlon Heading to protect the Imperial Valley from overflow. Debates the effect of diversion on river gradient and believes the confined flow of the Colorado between Arizona Mesa and the western levee may cause scour and eventual silting at Hanlon Heading. Opines that the silt problem may be solved by means of special settling basins, provided the proposed new heading is operated successfully.

J. A. OCKERSON, pp. 333-337, considers the evolution of the New River gorge and the effectiveness of dikes or jetties in deflecting currents from its banks. Disagrees with the statement that heavy bottom material affects the extent of scour. Recommends the return of the Colorado River to its former channel. Proffers a suggestion that the river bed be enlarged laterally to reduce flood height, diminish bank erosion, and facilitate bank revetment control. Points out the reduction of the water supply to Imperial Valley as a result of silt accumulation at the intake above the headgates. Contends that conservation, control, and use of Colorado River waters can be accomplished through the medium of a joint commission of United States and Mexican engineers.

THE AUTHOR, pp. 338-340, describes the flood of 1916 on the Lower Colorado, noting its effect on bank and stream-bed erosion. Presents a summary of arguments and discussions relative to the theory and practice of constructing a hydraulic fill dam to divert a stream flowing in an alluvial plain, considering the interdependence of velocity, scouring action, stream meandering, and character of river-bed material.

4. Conditions and prospects on the Colorado delta [abstract]. *Engin. News-Rec.*, vol. 98, no. 11, p. 444, Mar. 17, 1927.

A paper read before Los Angeles Section, American Society of Civil Engineers. Discusses the menace to the Imperial Valley from the silting up of the delta area through which Colorado River found outlets to the Gulf. Gives data on irrigation possibilities of Colorado River water. Notes that outlets to the Gulf have silted up and that deltaic cones are rising toward mountains at rate of 5-8 ft. with each flood. Proposes repairing breaks in levees, increasing levee construction, and constructing of new channel connecting the river mouth at the Gulf with the river channel near the southern boundary of Arizona.

ALLISON, WILLIAM F.

1. Stream pollution in the Pacific Northwest. *Amer. Soc. Civ. Engin., Trans.*, vol. 92, pp. 974-978, 1928.

A paper on the problems of stream and lake pollution in the Pacific Northwest. Describes stream pollution by mining debris, and the effect of its deposit on arable farming lands. Treats conditions of silt transportation which should govern the design of filtration systems.

ALTER, J. CECIL.

1. Mud floods in Utah. *Monthly Weather Rev.*, vol. 58, no. 8, pp. 319-321, illus., Aug. 1930.

Observations on the damage caused by the movement and deposition of erosional debris resulting from an extraordinary number of washing floods in the mountain sections of Utah during the first two weeks in August 1930 are presented.

ALTPETER, L. STANFORD.

1. Use of vegetation in control of streambank erosion in northern New England. *Jour. Forestry*, vol. 42, no. 2, pp. 99-107, illus., Feb. 1944.

Presents preliminary conclusions regarding basic principles on control of stream-bank erosion. Describes the use of vegetation for the control of stream-bank erosion on the Winooski River in Vermont.

ALVORD, JOHN W. See Phillips, H., 1.

AMERICAN SOCIETY FOR TESTING MATERIALS.

1. Report of Section on Sub-Sieve Sizes. *Amer. Soc. Testing Mater., Proc.*, vol. 28, pt. 1, pp. 640-644, table, 1928.

A report of the Section of Sub-Sieve Sizes of the Technical Committee IV on Size and Shape. Shows three different types of representation of results. Contains definitions and discussions of terms and symbols.

2. A. S. T. M. designation: D 422-39. Standard method of mechanical analysis of soils. *Amer. Soc. Testing Mater.*, Book of A. S. T. M. Standards, pt. 2, pp. 453-462, 1939.

Describes a method for the quantitative determination of the distribution of particle sizes in soils.

3. A. S. T. M. designation: E 11-39. Standard specifications for sieves for testing purposes. *Amer. Soc. Testing Mater.*, Book of A. S. T. M. Standards, pt. 2, pp. 853-859, 1939.

Consists of specifications which cover sieves for use in cases of precision testing for fineness of materials on classification according to size. Gives a table showing requirements for sieve openings and wire diameters with permissible variations. Includes a method of calibrating woven wire cloth sieves.

4. A. S. T. M. designation: C 115-42. Standard method of test for fineness of Portland cement by means of the turbidimeter. *Amer. Soc. Testing Mater.*,

Book of A. S. T. M. Standards, pt. 2, pp. 47-54, illus., 1942.

Covers the Wagner turbidimeter apparatus and procedure for determining the fineness of Portland cement as represented by the specific surface expressed as total surface area in square centimeters per gram of cement.

5. A. S. T. M. designation: C 136-46. Standard method of test for sieve analysis of fine and coarse aggregates. *Amer. Soc. Testing Mater.*, Book of A. S. T. M. Standards, pt. 2, pp. 467-469, 1946.

Describes a procedure for the determination of the particle-size distribution of fine and coarse aggregates by the use of sieves with square openings. The method is also applicable to the use of laboratory screens with round openings.

6. A. S. T. M. designation: C 117-48. Standard method of test for amount of material finer than No. 200 sieve in aggregates. *Amer. Soc. Testing Mater.*, Book of A. S. T. M. Standards, Sup., pt. 2, pp. 37-38, 1948.

Outlines a method for determining the total amount of material finer than a standard No. 200 (74-micron) sieve in aggregates.

7. A. S. T. M. designation: E 20-48T. Tentative recommended practice for analysis by microscopical methods for particle-size distribution of particulate substances of subsieve sizes. *Amer. Soc. Testing Mater.*, Book of A. S. T. M. Standards, pt. 3-A, pp. 385-394, 1948.

Describes a method for determining the particle size of pigments and similar materials in absolute units. Applies to homogeneous materials most efficiently to the range of sizes between 0.2 micron and 20 microns. Useful in cases where the particles are of such shape (needles, plates, etc.) as do not approximately obey Stokes' law. Comments on the micro-projection and photomicrographic methods of measurement. Treats of measurement scale and class size intervals. Calculation and expression of results are considered.

AMERICAN SOCIETY OF CIVIL ENGINEERS.

1. Flood control methods: their physical and economic limitations. Progress report of Committee of the Hydraulic Division of Flood Control. *Amer. Soc. Civ. Engin., Proc.*, vol. 66, no. 2, pp. 265-282, Feb. 1940.

A report embodying findings relative to a general appraisal of flood control methods with particular reference to their physical and economic limitations. Discusses the use of flood reservoirs to control drift carried by flood waters; the economic aspects of reservoir siltings; the effect of cut-offs upon conditions of sedimentation in streams; and the utility of erosion control measures to prevent flood damages due to sediment accumulations.

2. Conformity between model and prototype; A symposium. *Amer. Soc. Civ. Engin., Trans.*, vol. 109, pp. 1-117, illus., 1945.

Discussion: H. A. EINSTEIN, pp. 134-139, comments on friction as a cause of deviation between model and prototype. Questions the reliability of distorted model tests because of a visit to the U. S. Waterways Experiment Station where he noted how much the natural roughness of a model must be increased to counteract the effect of distortion on friction. Points out that the writer and R. Müller have described conditions under which a distorted model with movable bed will conform to the prototype, presenting the results of the method applied to a river model, the Rhine River above Lake of Constance. Bed-load measurements gave rate of bed-load movement; the Swiss formula was used in calculating rate of bed-load movement. Points out that the knowledge of the fundamental laws of bed movement is unsatisfactory; therefore, it is not possible to build quantitative models for large streams with fine sediment.

AMERICAN SOCIETY OF CIVIL ENGINEERS, COMMITTEE ON CONSERVATION OF WATER.

1. Conservation of water—progress report of the Committee of the Irrigation Division. *Amer. Soc. Civ. Engin., Proc.*, vol. 61, no. 10, pp. 1483-1491, Dec. 1935.

Notes studies dealing with the transportation of erosional debris, and with water-spreading and flood channel construction works. Conclusions of Committee relative to engineering principles relating to check dams are given.
Discussion: DEAN C. MUCKEL, (Amer. Soc. Civ. Engin., Proc., vol. 62, no. 4, pp. 608-610, Apr. 1936), comments upon complications involved in water spreading and flood-channel maintenance due to conditions of silt transportation and deposition. Notes methods of silt control on spreading systems.

AMERICAN SOCIETY OF CIVIL ENGINEERS, HYDRAULIC DIVISION, COMMITTEE ON HYDRAULIC RESEARCH.

1. Hydraulic models. Amer. Soc. Civ. Engin., Manuals of Engin. Practice, no. 25, 110 pp., illus., 1942.
 A manual dealing with hydraulic model studies. Treats such subjects as experimental hydraulics, principles of hydraulic similitude, Newton's general law of motion, special model laws, hydraulic tables, dimensional analysis, design, construction, and operation of hydraulic models.

AMERICAN SOCIETY OF CIVIL ENGINEERS, SPECIAL COMMITTEE ON FLOODS AND FLOOD PREVENTION.

1. Final report. Amer. Soc. Civ. Engin., Trans., vol. 81, pp. 1218-1230, 1917.
 Discusses need for flood-control measures and deficiency of flood-control data. Summarizes suggested methods of flood control. Discusses insufficiency of stream-flow data, noting contingencies which exist in sedimentary streams. Effects of the amount and character of sediment carried in streams on flood control measures are examined. Discusses use of barriers, channel enlargement and cut-offs, levee and out-let systems, and use of reservoirs and detention basins as flood-control measures noting conditions of the transportation and deposition of debris and sediment.
Discussion: MYRON L. FULLER, pp. 1269-1278, dissents upon geological studies in relation to flood control and describes conditions of stream degradation and aggradation, flood-plain upbuilding, and terracing. Points out that such factors as deltas or fans, rock barrier, and other geological factors are to be considered in devising flood-control works. Outlines the conditions of transportation and deposition of sediment by operation of sedimentation basins and levee and outlet systems, and their relation to flood control.

AMIDON, ROGER E. See Bermel, K. J., 1.

ANDERSON, ALVIN G. See also Einstein, H. A., 2; Kalinske, A. A., 12.

1. A combination suspended-load sampler and velocity meter for small streams. U. S. Dept. Agr. Cir. no. 599, 26 pp., illus., Feb. 1941.
 Describes an instrument that will simultaneously collect suspended-load samples from, and measure the velocity of, small streams. Discusses the development, construction, calibration, use, and hydraulics of the instrument.
2. Distribution of suspended sediment in a natural stream. Amer. Geophys. Union, Trans., vol. 23, pt. 2, pp. 678-683, 1942.
 Discusses a study made on a segment of the Enoree River to determine the distribution of sediment. Discusses procedure used. Presents data to further substantiate the theory of sediment-suspension and the demonstration of the applicability of an equation of this form to the conditions of nature.

ANDERSON, E. P. See Griffith, W. M., 1.

ANDERSON, G. E.

1. The age of rounded sand grains. Okla. Acad. Sci., Proc., vol. 6, pt. 2, pp. 265-267, 1926.
 Considers the comparative efficiency of water and wind in rounding sand grains. Rate of wear on sand submerged in water is considerably more than dry sand rolled over an equal distance. No perceptible rounding of grains at 500 miles of wear in rotating barrel. From slow rate of wear indicated by experiments it is not likely that sand grains become rounded in a

single journey from the central part of the continent to the sea, but probable that they pass through several cycles of erosion, transportation, and deposition.

2. Experiments on the rate of wear of sand grains. Jour. Geol., vol. 34, no. 2, pp. 144-158, Feb./Mar. 1926.

Experiments conducted to determine the relative rates of mechanical wear on sand grains by wind and by water under constant conditions. Samples taken from river and dune sands on the Canadian River, near Norman, Okla., show that sand submerged in water wears down more rapidly than wind-borne sand over the same distance. Ratio of rate of wear of water and wind-transported sand are given. Rounded or spheroidal sand grains are believed to be very old geologically.

ANDERSON, GEORGE G.

1. The construction, maintenance and operation of large irrigation canals. Denver Soc. Civ. Engin. Architects, Trans., 1, pp. 23-42, 1890.

Discusses the various factors to be considered in the construction, maintenance and operation of large irrigation canals. Considers briefly the prevention and removal of silt from canals.

ANDERSON, HENRY W.

1. Flood frequencies and sedimentation from forest watersheds. Amer. Geophys. Union, Trans., vol. 30, no. 4, pp. 567-584, illus., tables and graphs, Aug. 1949.

Uses a multi-watershed, multi-storm, multi-variable approach for developing a hydrologic basis for evaluating flood control in southern California. Notes that the flood peak discharge is related to six variables. Determines the relationship of reservoir sedimentation to maximum peak discharge, main channel area, and density of forest cover; with discharge frequency this gave a method of determining sedimentation frequency and mean annual sedimentation. Multiple regression analysis was used as an aid in the study. Evaluates the effect of forest fires on peak discharges and sedimentation from the determinations of effectiveness of forest cover for 41 watersheds.

Discussion: LEONARD SCHIFF, pp. 584-586, comments on the information presented by the author. Considers the problem of the influence of cover on peak discharges and Mr. Anderson's treatment of this problem.

ANDERSON, J. D. See Buck, Sir C. E., 2.

ANDERSON, NORVAL E. See Camp, T. R., 2.

ANDERSON, S. T.

1. (and Spaulding, Charles H.). Moving the Springfield water works. Amer. Water Works Assoc. Jour., vol. 30, no. 4, pp. 585-593, Mar. 1938.

Discusses construction of water supply development, known as Lake Springfield, on Sugar Creek, Ill., and describes work of planting on marginal land of the lake to control lake turbidities and to retard the rate of reservoir silting.

ANDERSON, W. E. See Mead, E., 5.

ANDREWS, E. C.

1. Erosion and its significance. Roy. Soc. N. S. Wales, Jour. and Proc. (1911), vol. 45, pp. 116-136, 1912.

Presents various steps in the formation of a peneplain and gives several important applications of reasoning to geological problems. The effects on land sculpturing by streams, by forces of erosion, transportation of debris by streams, floods, form of stream channel, depths and width of canyons in plateaus, corrosion above canyon walls, and subsequent states of reduction are discussed. Applications of author's reasonings are: (1) to derive height of peneplain above sea level; (2) to compute earth's age based upon present estimated rate of denudation; and, (3) to explain peculiarities of certain topographies.

ANDREWS, F. M.

1. Forests and floods. Ind. Acad. Sci. Proc., 1913, pp. 203-212, 1914.

Deals with the effect of forests on stream flow, and depicts the disastrous effects of Ohio River flood of 1913 due to deforestation in Indiana.

Notes damage to bottom lands by deposits of debris and stones. Extent of sediment removed to sea annually by rivers of the United States, rapidity of transportation, and source of sediment are briefly noted.

ANTEVS, ERNST.

1. Varved sediments. Natl. Res. Council, Reprint and Cir. Ser., no. 92, pp. 61-65, 1930.

Discusses characteristics of composite varved sediments (annual deposit of glacial clay), periodicity in glacial melting displayed by graphs of the varved glacial clay, and conditions of correlation between varved late glacial clay. Describes briefly field studies of varved clay in New Jersey. Occurrences of new varved sediments are noted.

2. Varved sediments. Natl. Res. Council, Reprint and Cir. Ser., no. 98, pp. 51-53, 1931.

Reviews investigations relative to conditions of the modern deposition of varved sediments. Discusses work of H. J. Fraser on the determination of the relative values of some factors affecting this formation of varved clay sediments, and Kindle's observations at Lake Cavell (Canada). Study of composite varves by R. W. Sayles. Study by G. De Greer on the recording varves of solar radiation. Notes studies of new varved sediments by W. H. Bradley and W. W. Rubey.

3. Recent European studies on sedimentation. Natl. Res. Council Bul. no. 98, pp. 16-20, July 1933.

Summarizes results of recent investigations by G. Lundgren on the evolution of lakes in southern Sweden and by R. Brinkmann on stratification in sediments. Conditions of and factors affecting stratification are discussed with reference to the work of the latter investigator.

4. Varved sediments. Natl. Res. Council, Bul. no. 98, pp. 21-23, July 1935.

Presents results of studies regarding conditions of formation of varved glacial clay deposits in lakes of Denmark and southern Skane. Discusses the measurement of varves and the significant features of the clays and their formation, effect of river currents and temperature and density of lake water upon dispersion of the mud; effect of flocculation upon rate of settling; temperature and other physical properties of lake water as factors affecting flocculation. Other conditions possibly responsible for composite varve formations are noted.

APFEL, EARL T.

1. Phase sampling of sediments. Jour. Sedimentary Petrology, vol. 8, no. 2, pp. 67-68, Aug. 1938.

Notes that the unit mass samples for basic studies should be the phase which represents one period of fluctuation of the transporting capacity of the transporting agent.

APPALACHIAN NATURAL FOREST ASSOCIATION.

1. Deforestation [letter and editorial response]. Stone and Webster Pub. Serv. Jour., vol. 2, pp. 650-654, Mar. 1908.

Letter to Columbus Water Power Company requesting data showing the evil effects of deforestation. Response by the editor gives briefly the effects of deforestation upon floods and silt accumulations in rivers.

ARCHANGELSKY, B. V.

1. (and Mortinov, P. F.). Methods for the determination of the mechanical composition of suspended silt. Sci. Res. Inst. Hydrotechnics, Trans., 12, vol. 19, pp. 144-179, 1934. In Russian. Translation on file at U. S. Soil Conservation Service, Washington, D. C., and the University of California, Berkeley, Calif.

Discusses various methods used for the determination of the mechanical composition of suspended silt. Gives various operations in the determination of suspended sediment. Separation of the suspended sediment consists of direct settling out of the suspensions and use of electrolytes such as hydrochloric acid, calcium chloride, and ammonium hydroxide. Gives data on various tests and results of mechanical analyses. Comments on Sabanins' and Apollonov's methods. Discusses the fraction-meter which

separates the sample into fractions according to their hydraulic sizes.

ARMAND, L.

1. (and Pascalon, P.). Regularisation and canalisation works of rivers and streams. Internatl. Cong. Navigation, 15, 1931, Rpt. 16, 18 pp., illus.

Discusses the regularization of rivers with movable beds by constricting channels with dikes and use of sills. Discusses in detail, studies of transportation and deposition of suspended and bed load in streams.

ARMSTRONG, H. K. See also Einstein, H. A., 11.

1. Sedimentation program of the Corps of Engineers. Fed. Inter-Agency Sedimentation Conf., Proc. 1947, pp. 39-42, 1948.

Discusses the program of the U. S. Corps of Engineers in the field of sedimentation. The article is a resumé of activities of the various division offices of the Corps of Engineers.

ARNOLD, H. D.

1. Limitations imposed by slip and inertia terms upon Stokes' law for the motion of spheres through liquids. London, Edinb. and Dublin Phil. Mag. and Jour. Sci., (ser. 6), vol. 22, no. 131, pp. 755-775, Nov. 1911.

Points out that it is possible to make metallic spheres to verify Stokes' law in the less viscous oils. Considers limitations imposed by slip and inertia terms upon Stokes' law.

ARROYO, SALVADOR.

1. Channel improvement of Rio Grande below El Paso. Engin. News-Rec., vol. 95, no. 10, pp. 374, 376, illus., Sept. 3, 1925.

Report on the control works for the Rio Grande between El Paso and Fort Quitman, below Elephant Butte Dam. The river bed is rising because of silt deposition and in turn endangering El Paso, Jaurez and adjacent irrigation projects with floods. The character of the banks on both the American side and the Mexican side is discussed and the need for river rectification determined. A plan for levee construction is outlined.

ASCOLI, F. D.

1. The rivers of the Delta. Roy. Asiatic Soc. Bengal, Jour. and Proc., n. s., vol. 6, pp. 543-556, 1910.

Points out some of the important changes based on local information, old maps and papers, and actual observation which have occurred in the courses of the Ganges and Brahmaputra Rivers during the past 150 years, especially in the Rajnagar area. Causes and effects of the sequence of changes due to the oscillation of the rivers are discussed.

ASHE, W. W. See also Ayres, H. B., 1.

1. Relation of soils and forest cover to quality and quantity of surface water in the Potomac Basin. U. S. Geol. Survey, Water-Supply Paper 192, pp. 299-335, illus., 1907.

Discusses the effect of various soil types, manner of tillage, and conditions of forest cover on the quantity and quality of surface waters in the Potomac River Basin. Important soil formations east and west of the Allegheny front are considered in relation to their effects on the turbidity of the Potomac and its tributaries, erodibility, and transportability of soils. States that valuable farming soils contribute largely to the turbidity of the Potomac, and the clearing of forests would result in increased turbidity. Notes need for extensive reforestation. Discusses conditions of erosion on farm lands noting the necessity of absorption of rain water to maintain soil fertility by retaining in it the solid silt and clay and soluble plant food. The effect of forest cover on stream flow and the extent and influence of forest cover on stream turbidity, potability of waters, and bank erosion (by equalizing flow) on small streams are discussed. Gives data relative to turbidity in reservoirs and of water-supply at Washington, D. C.

2. Special relations of forests to rivers in the United States. U. S. Inland Waterways Comm. Prelim. Rpt., 60th Cong., 1st sess., S. Doc. no. 325, pp. 514-534, 1908.

- Discusses influences of forest upon stream flow in six different river groups in the United States, each group within a region having similar physiographic and climatic characteristics. Includes data on erosion and siltation for each group. Discusses the extent of the physical influences of forests as it varies with watershed conditions, topography, climate, and soil, on stream flow and silt production in rivers of Northeastern States and Great Lakes region, Middle Atlantic Coast region, Appalachian rivers, rivers flowing from eastern and southern slopes of the Rocky Mountains, Sacramento and San Joaquin rivers, and the Columbia River. Silt burdens of streams of eastern New England are small and limited to material eroded from banks and material scoured in rapid portions of streams. Stream channels of Penobscott, Androscoggin, and Merrimac Rivers are generally free from silt bars. Erosion on watershed of Connecticut River is more active resulting in silt bar formation in its tidal channel necessitating reforestation at headwaters. Hudson River during freshets carries a silt burden amounting to 240,000 tons a year. Mississippi River above Minneapolis discharges annually 117,000 tons of silt. Streams of Middle Atlantic Coast are subject to frequent floods accompanied by large silt burdens. Susquehanna River at Danville discharges 240,150 tons of sediment annually; James River in flood with a 10-ft. crest moves in 24 hr. from 275,000 to 300,000 cu. yd. of solid matter. Watershed conditions of Southern Appalachian streams have increased the frequency and extent of floods, and increased deposits of sand and silt in channels and reservoirs; Alabama River bears off annually 3,038,900 tons of soil; Savannah carries 1,000,000 tons removed from area above Augusta, Ga. Roanoke deposits more than 3,000,000 tons in its own channel and Albemarle Sound. Tennessee River discharges nearly 11,000,000 tons annually. Silt burdens of rivers of the eastern slopes of the Rocky Mountains are the highest of all streams in the United States. Missouri River above Ruegg has an annual silt load of 176,000,000 tons. Arkansas River above Little Rock discharges more than 40,000,000 tons of earth. Brazos River above Waco carries more than 3,200,000 tons. Platte, Trinity, Sabine, Colorado (of Texas) and Rio Grande Rivers bear high silt burdens. Sacramento River carries annually 2,250,000 tons of solid material. Salient features of Columbia River are its uniformity of flow and clarity of water. Effect of forests on purity of stream waters and the relation of forests to engineering methods of stream control are discussed.
3. The waste from soil erosion in the South. Amer. Rev. of Reviews, vol. 39, no. 4, pp. 439-443, illus., Apr. 1909.
Describes briefly conditions of soil erosion in southeastern United States, noting annual sediment burdens of various streams of the region. The effects of accelerated erosion upon stream turbidities, flood, and silting in streams and reservoirs are considered.
 4. Soil erosion and forest cover in relation to utilization of water power with special reference to the Southeast. Engin. World, vol. 23, no. 2, pp. 73-75, Aug. 1923; [abstract], Engin. News-Rec., vol. 91, no. 8, p. 307, Aug. 23, 1923.
Considers the silting up of reservoirs due largely to the removal of protective cover on watersheds. Need for reservoir protection to insure permanence is discussed. Summarizes surface conditions, rainfall, and amount of solid matter carried by streams in different parts of the United States. A table shows flowage and turbidity of typical streams in different hydrographic regions.
 5. Financial limitation in the employment of forest cover in protecting reservoirs. U. S. Dept. Agr. Bul. 1430, 34 pp., illus., Aug. 1926; [abstracts], Mod. Irrig., vol. 2, no. 11, pp. 48-49, Nov. 1926; Engin. News-Rec., vol. 98, no. 14, p. 573, Apr. 7, 1927.

Points out the value of forest cover and the financial limitations in its employment to prolong the useful life of reservoirs. Discusses the economic aspects of reservoir silting, the protective influence of forests on silting in streams and reservoirs, sources of solid loads of streams, and value and costs of forest and other cover in reducing soil erosion. Regional conditions of rainfall, surface and soil which cause excessive erosion, silt burdens of streams, and means of reducing erosion for the protection of water-power resources are described. Presents data for typical streams in different hydrographic regions of United States, on comparative turbidity, relation between maximum and minimum flow, and precipitation on watershed.

ASHLEY, GEORGE H.

1. Old mountain theories are challenged by findings. Pa. Dept. Int. Aff. Mo. Bul., vol. 8, no. 2, pp. 15-21, illus., Jan. 1940.

Describes the carving of the present surface of the Appalachian region from an uplifted arched segment of the earth's crust. Discusses rates and factors involved in the lowering of mountain tops and valleys, as well as rates of land surface reduction. Reservoir silting surveys by the Soil Conservation Service for nine reservoirs on the Atlantic slope indicate an average of 1 ft. of surface lowering in 1,118 years.

ASHMEAD, D. C. See Sisler, J. D., 1.

ATHY, L. F.

1. Density, porosity, and compaction of sedimentary rocks. Amer. Assoc. Petrol. Geol. Bul., vol. 14, no. 1, pp. 1-24, illus., Jan. 1930.

Discusses laboratory method of obtaining bulk volume of rock samples, also relation between depth of burial, density, porosity, and compaction of different types of sedimentary rocks. An approximate idea of the depth of material eroded from a given area may be obtained by study of its density or porosity.

ATKINSON, JOHN DEKEYNE. See Butcher, A. D. D., 2.

ATLANTA, GA., BOARD OF WATER COMMISSIONERS.

1. Superintendent's report, 1876. Atlanta Bd. Water Commrs., Ann. Rpt., 1876, 2, pp. 6-25, 1877.
Notes the effect of setting of Bermuda grass on watershed of city's reservoir to prevent the muddying of the water.
2. Superintendent's report, 1877. Atlanta Bd. Water Commrs., Ann. Rpt., 1877, 3, pp. 5-24, 1878.
Notes effect of setting of Bermuda grass on watershed of city reservoir to prevent the flow of muddy water into the pond and the effectiveness of the stand-pipe in procuring a clear supply.

ATWOOD, WALLACE W.

1. (and Peattie, Roderick). Saving the silts of the Mississippi River [abstract]. Geol. Soc. Amer. Bul., vol. 28, no. 1, pp. 149-151, Mar. 1917.

A plan to reclaim lower Mississippi Valley waste lands by utilizing river silt. Notes vast areas of waste lowlands suitable for improvement and outlines plan to gradually raise land levels by flooding with silt-laden water. Notes Mississippi annually carries to Gulf enough silt to cover one square mile 268 ft. deep. E. W. Shaw in a discussion, says the chief difficulty of applying plan to Mississippi Valley is that of transporting an appreciable amount of sediment any distance from river; bulk of silt would deposit on natural levees.

ATWOOD, WILLIAM G. See also Curd, W. C., 1.

1. Protection of river banks with spur dikes [letter to editor]. Engin. News-Rec., vol. 87, no. 2, pp. 78-79, illus., July 14, 1921.
Comments on letters (Engin. News-Rec., vol. 86, no. 21, p. 909; no. 24, p. 1047, May 26, June 16, 1921) with regard to spur dike river bank protection on Missouri River. Current "retard system" of dikes used to stop erosion and promote silting. Deposition below one retard at Rulo, Nebr., amounted to fill of 9 ft. in one week. "Retard system" is cheaper than mattress revetment.

AUDOUIN, L.

1. The control of rivers with unstable beds, with special reference to the Loire. U. S. Engin. School, Occas. Papers 34, pp. 27-40, illus., 1908.

Presents a description of oblique dams with sluice gates constructed in the vicinity of Angers for the improvement of the Loire River. Reference is made to Fargue's determinations relating to rivers whose channels are liable to frequent movements, and to the law that in a winding channel the deepest portion is excavated along the concave bank. In the case of the Loire, it is recognized that gravel and pebbles which form sills or banks are transported along the bed, and the use of oblique dams as illustrated on the Loire avoids deposition of the gravel. The construction of the dam, the scouring effect produced, the alterations in the bed, and the gradual accumulation of sand behind the barrier are explained.

2. Sketch of a new method of improving rivers with erodible bottoms. U. S. Engin. School, Occas. Papers, 34, pp. 11-25, illus., 1908.

Describes and discusses a method which utilizes the force of the current for the improvement of rivers with erodible bottoms, using Loire River between Nantes and the Maine as the basis of description. Method involves natural bank regulation and reclamation and the construction of an artificial channel through bars by employing a particular arrangement of oblique dams with suspended gates.

AYERS, A. H.

1. Sun River Project, Montana. Reclam. Rec., vol. 9, no. 8, p. 389, Aug. 1918.

Notes that during flood stage of Sun River, water in large quantities was admitted into the Pishkun Canal to take advantage of the unusual amount of silt carried in the river to seal the lake.

AYRES, H. B.

1. (and Ashe, W. W.). The southern Appalachian forests. U. S. Geol. Survey, Prof. Paper 37, 291 pp., illus., 1905.

Describes forest conditions in the various drainage basins in the Southern Appalachians. Includes a brief discussion on damages by floods in the Watauga, Nolichucky, and Hiwassee River basins. Conditions of erosion and deposition are described. Illustrations show infertile sand deposits over soils of the Catawba River lowlands.

AYRES, QUINCY C.

1. Ditch design and prevention of silt deposits. Iowa Engin. Soc., Proc., vol. 33, pp. 38-42, 1921; [abstract], Engin. News-Rec., vol. 86, no. 14, pp. 647-648, Apr. 14, 1921.

Considers the factors involved in the design of drainage ditches with special reference to the reduction in maintenance costs by the elimination of sedimentation.

2. Special problems in open ditch designs. Agr. Engin., vol. 2, no. 5, p. 105, May 1921; [abstracts], Engin. News-Rec., vol. 86, no. 15, pp. 647-648, Apr. 14, 1921; Engin. and Contract., vol. 55, no. 6, p. 142, Feb. 9, 1921.

Reports relation of velocity, depth, and breadth in open ditch designs to sedimentation. Notes that the silt-carrying capacity of water varies directly with function of velocity and inversely with depth of ditch. To avoid silting in any canal the mean velocity of streams should be increased with depth. Cites formulas expressing the relation between "critical velocity" and depth.

3. Recommendations for the control and reclamation of gullies. Iowa Engin. Expt. Sta. Bul. 121, 71 pp., illus., Mar. 13, 1935; [abstract], Commonwealth Engin., vol. 23, no. 5, pp. 151-152, Dec. 2, 1935. States that 35,000,000 acres of land were ruined and 100,000,000 acres damaged by erosion in the United States during 1910. Five hundred thirteen million tons of suspended silt and 270,000,000 tons of the dissolved matter are washed from land each year, at an annual loss of approximately \$400,000,000.

BABB, CYRUS C.

1. The hydrography of the Potomac Basin. Amer. Soc. Civ. Engin., Trans., vol. 27, no. 537, pp. 21-33, illus., July 1892.

Deals with various hydrographic conditions

existing in the Potomac River Basin. Notes establishment of a gauging station at Chain Bridge 3 miles above Washington, D. C.; describes mode of operation and reporting results obtained. Outlines regime of the Potomac River, drainage area, monthly rainfall and main physical differences of its tributaries. Method of measurement of suspended matter carried in stream is described. Sediment curve of estimated silt in suspension at Great Falls, Md., during 1890, is given.

Discussion: H. F. DUNHAM, p. 35, suggests that studies made of the Potomac could be repeated in relation to the Connecticut, Merrimac, or Penobscot Rivers which have been affected by glacial action. Notes that in determining the amount of sediment, some other method than that described might be introduced.

2. The sediment of the Potomac River. Science, vol. 21, no. 542, pp. 342-343, June 23, 1893; [abstract], Engin. News, vol. 30, p. 109, Aug. 10, 1893.

Presents results of measurements taken by U. S. Geological Survey from 1886 to 1891 to determine discharge of the Potomac River and its relation to rainfall, and to determine amount of silt transported by the river. Describes laboratory method of determining "condition of water," corresponding ratio of sediment, and total amount of sediment transported. Average annual amount of sediment transported during period is estimated to be 5,557,250 tons, a ratio of 1:3,575 of average annual sediment discharge to annual water discharge. Similar data are presented for Rio Grande and Mississippi, Uruguay, Rhone, Po, Danube, Nile, and Irrawaddy Rivers.

BABBITT, H. E. See Caldwell, D. H., 1; Wilson, W. E., 1.

BACKES, W. J. See Fristoe, R. E., 1.

BAGNALL, GERALD.

1. Improvement of the mouth of the Columbia River. Prof. Mem., vol. 8, no. 42, pp. 687-720, illus., Nov./Dec. 1916.

Describes methods and equipment for the construction of jetties at the mouth of the Columbia River. The source of sediment accumulations at the mouth of the stream and factors affecting their movement are briefly discussed.

BAGNOLD, RALPH ALGER.

1. Sand movement by waves; some small-scale experiments with sand of very low density. Inst. Civ. Engin. Jour., vol. 27, no. 4, pp. 447-469, illus., Feb. 1947.

Deals with the stability of a horizontal bed in shallow water, the conditions being such that the waves have not begun to break. A new artificial sand of very low density, crushed Perspex, a plastic, was used in the experiments. The advantage of Perspex over quartz is that long standing in the water produces no apparent biological contamination of the water. Treats water motions concerned with sand transport.

BAILEY, FRANK S. See Johnson, Joe W., 8.

BAILEY, PAUL.

1. New form of bank protection on the Sacramento River. Engin. News-Rec., vol. 97, no. 5, pp. 190-191, illus., July 29, 1926.

Describes bank protection works on the Sacramento River. Discusses causes of bank erosion and describes series of jetties devised to ward off river currents from exposed sand strata and to effect deposits of silt for the growth of vegetation.

BAILEY, REED W.

1. (and Forsling, C. L., and Becraft, R. J.). Floods and accelerated erosion in northern Utah. U. S. Dept. Agr., Misc. Pub. 196, 21 pp., illus., Aug. 1934.

Presents results of studies conducted by the Intermountain Forest and Range Experiment Station in cooperation with the Geology Department and the Agricultural Experiment Station of the Utah State Agricultural College on conditions of recent floods and accelerated erosion in northern Utah; also geologic evidence to show that recent floods, chiefly due to depletion of plant cover on watersheds, constitute abnormal erosion and runoff. Effects of destructive

- floods of 1923 and 1930 are described. New channeling of deltas, deposition of flood debris in valleys, excessive scouring in canyon fill, and comparison with erosion deposits of streams having watersheds barren of vegetation evidence the radical change from normal erosion and sedimentation in the canyons of the Centerville-Farmington area.
2. Shackling the mountain flood. Amer. Forests, vol. 41, no. 3, pp. 101-104, 150, illus., Mar. 1935. Notes conditions of erosion and the deposition of erosional debris and describes work of the C. C. C. in the construction and promotion of flood and erosion control measures in the Wasatch Mountain area, Utah.
 3. (and Connaughton, Charles A.). The western range, its social and economic function in watershed protection. 74th Cong., 2nd sess., S. Doc. 199, pp. 303-339, illus., 1936. Considers the flood and erosion menace. Causes of accelerated erosion and floods are noted. Problems of silt, storage reservoirs threatened by silt in the Southwest, and silt deposition in irrigation canals are considered. Points out the importance of watershed protection and methods of protection dependent upon controlled management. Includes a map of the Western States showing important water-yielding and silt-producing areas.
 4. Land-erosion—normal and accelerated—in the semiarid West. Amer. Geophys. Union, Trans., vol. 22, pt. 2, pp. 240-250, illus., Aug. 1941. Cites examples, using a geomorphological approach for the understanding of the problems of erosion and floods in the semiarid West. Notes that the record of past erosion, present erosion, and runoff, is written in the land surface. This evidence is useful in the interpretation of the relation of current gradational processes to normal and in the determination of the causative factors. Evidence shows low rates of erosion and runoff are due to the development of a plant and soil mantle. The deterioration of plant cover accelerates erosion and runoff. Discussion: ROBERT T. KNAPP and HUGH STEVENS BELL, pp. 257-261, consider that density currents form one subdivision of the problem of transportation and deposition of eroded sediments. Treats of the causes and conditions of flow of density currents, the visual surface evidences of underflow in reservoirs, the geological significance of density currents, and the engineering significance of density currents with particular reference to location and rate of deposition in reservoirs and to the transport of sedimentary material through reservoirs. Illustrations show consecutive stages in the passage of a series of underflows through a laboratory reservoir.
 5. (and Craddock, George W.). Watershed management for sediment control. Fed. Inter-Agency Sedimentation Conf., Proc. 1947, pp. 302-310, illus., 1948. Discusses the problem of the erosion of the soil mantle and effect of plant cover. Shows the effect of misuse of land and the advantages of a watershed management program. Beneficial results of such a program in Davis County, Utah are noted. The major job ahead is pointed out. Discussion: RALF R. WOOLLEY, pp. 310-312, comments on work of Forest Service in watershed management. The effects of man's abuse of the lands is discussed. W. J. ENDERSBEE, pp. 312-314, points out the need for the correlation and integration of programs for conservation of soil and water resources.
 6. A symposium—watershed management in relationship to water runoff and siltation—reducing runoff and siltation through forest and range management. Jour. Soil and Water Conserv., vol. 3, no. 1, pp. 24-31, illus., Jan. 1948. Discusses various factors concerned with the reduction of runoff and siltation through forest and range management. Comments on floods in the humid East, snowbelt floods in the West, prolonged western rain floods, cloudburst floods. Notes control of potential summer debris floods and treats the limitations of watershed management.
- BAKER, BENJAMIN.
1. The River Nile. Van Nostrand's Engin. Mag., vol. 23, no. 143, pp. 406-413, Nov. 1880. Presents various data on heights, discharge, and quality of the waters of the River Nile; on solids in suspension and dissolved matter carried by the Nile (June 1874-May 1875); on results of chemical analyses of Nile silt; and on the fertilizing value of the suspended matter of the Nile.
- BAKER, C. L.
1. A preliminary study of Reelfoot Lake with suggestions for possible improvements. Tenn. Acad. Sci. Jour., vol. 15, no. 1, pp. 4-20, illus., Jan. 1940. Considers the problem of proper lake levels of Reelfoot Lake, Tenn.; evidences for filling in the lake and how this may be controlled; the vegetation problem and its control; reasons for opening of certain channels and digging of connecting ditches; results of a quantitative analysis of bottom material in the lake; the relation of aquatic life in the lake to filling in by washed-in sediment; causes of siltation in the lake; and siltation control by erosion control on nearby hillsides and bottom-land farms. Measures to improve conditions for hunting, fishing, and recreation are discussed.
- BAKER, D. M. See also Lynch, H. B., 1.
1. Reservoir silting and soil erosion [letter to editor]. Civ. Engin., vol. 3, no. 5, p. 286, May 1933. Comments on Influence of Overgrazing on Erosion and Watersheds (Chapman, H. H., 3). Loss of capacity of southwestern reservoirs during the last 10 or 20 years is not great in the aggregate. Useful life of Elephant Butte Reservoir is estimated to be 140 years and Hoover Reservoir, 280 years. Capacity can be added by raising the height of dams, storage on other sites, or reducing erosion rate. Increased erosion of the Navajo country is due to grazing sheep and goats which destroy soil and grass cover by their small feet. Since grazing started in the nineties, ravines have grown 50 ft. deep with no increase in annual rainfall.
- BAKER, HERBERT ARTHUR.
1. On the investigation of the mechanical constitution of loose arenaceous sediments by the method of elutriation, with special reference to the Thanet beds of the southern side of the London Basin. Geol. Mag., vol. 57, no. 673, pp. 321-332, illus.; no. 674, pp. 363-370, illus.; no. 675, pp. 411-420, illus.; no. 676, pp. 463-467, illus., July-Oct., 1920. Consists of a detailed investigation of the Thanet beds of southern England by means of mechanical analysis using the elutriation method. Considers revised methods of experiment in carrying out mechanical analyses. Calculates the speeds of currents competent to transport Thanet bed material. Considers such items as the graphical expression of mechanical analysis, characteristics of elutriation-curves of sediments, etc.
- BAKER, SHELDON K.
1. Water supply of Arizona. Ariz. State Planning Bd., Rpt., vol. 2, pp. 161-231, illus., Dec. 1936. Considers the various aspects of water supply in Arizona. Includes brief discussion on the quality of surface waters in the lower Colorado and Gila River Basins. Notes conditions of sediment transportation and deposition, silting in canals and ditches, silting up of storage reservoirs, and retrogression and degradation below dams. Notes that a survey made by the Salt River Valley Water Users Association in 1934 showed that, during 24 years of operation, the total deposit of sediment in Roosevelt Reservoir amounted to 108,000 acre-feet or an average of .88 acre-feet per annum per sq. mile of drainage area.
- BAKER, W. F. See Wallace, R. C., 1.
- BAKHMETEFF, BORIS A. See Kalinske, A. A., 2.
- BALLANTYNE, A. M.
1. The prevention of erosion at the foot of weirs. Civ. Engin. [London], pp. 287-294, Aug. 1938. Describes experimental work carried out in the James Watt Engineering Laboratories, University of Glasgow. A model was used to investi-

- BALLANTYNE, A. M. - Continued
gate the problem of erosion in channels.
Various data are given and results noted.
- BALLESTER, R. E. See Griffith, W. M., 1; Lane, E. W., 4.
- BALLOU, W. H.
1. Improvement of the Mississippi River. Engin. News, vol. 7, pp. 394-395, Nov. 20, 1880.
Describes the river bed, noting sedimentary deposits of from 60 to 100 ft. and lateral oscillations. Discusses causes and mode of bank erosion in the Mississippi and Missouri Rivers and methods of bank protection.
- BALTIMORE, MD. WATER BOARD.
1. Water Engineer's report, 1872. Baltimore Water Dept., Ann. Rpt. 1872, pp. 53-97, 1873.
Dredging operations at Lake Roland and proposed means of keeping silt from entering the lake are briefly described.
2. Water Engineer's report, 1872-3. Baltimore Water Dept., Ann. Rpt. 1872-73, pp. 37-75, 1874.
Notes progress in cleaning out Lake Roland and the quantity of material removed to Dec. 7, 1872.
3. Report, 1900. Baltimore Water Dept., Ann. Rpt. 1900, pp. 3-25, 1901.
Dredging operations at Lake Roland and Loch Raven are described. Total sediment removed, proposed operations, and costs are given.
4. Report, 1904. Baltimore Water Dept., Ann. Rpt. 1904, pp. 3-20, illus., 1905.
Describes dredging operations at Loch Raven, extent of material removed, and disposal of material. Discusses cost of operations, improvements to water service, and proposed construction of reservoir in Gunpowder River watershed to protect stream from pollution and silting.
5. Report, 1905. 95 pp., illus., Baltimore, Md., 1906.
Discusses proposed construction of reservoir and appurtenant works above Loch Raven to increase water supply and keep muddy water out of Loch Raven, dredging operations at Loch Raven, extent of material removed, and costs (pp. 11-17).
6. Report, 1906. Baltimore Water Dept., Ann. Rpt. 1906, pp. 3-19, illus., 1907.
Notes dredging operations at Loch Raven and extent of material removed.
7. Special report of the Water Engineer. Baltimore Water Dept., Ann. Rpt. 1906, pp. 20-29, 1907.
Improvements to method of removal of sediment from Loch Raven are noted.
8. Report, 1910. 81 pp., illus. Baltimore, Md., 1911.
Notes that the cultivation of land adjoining the upper end of Loch Raven was chiefly responsible for considerable silting in the reservoir; the land should be allowed to grow up in grass to remedy the problem (p. 15). Notes dredging operations at Loch Raven, extent of material removed, and costs (p. 78).
9. Annual report...for the year ending December 31, 1913. 220 pp., illus. Baltimore, Md., 1914.
In connection with Gunpowder River water supply improvements, conditions of silting and dredging operations in old Loch Raven and Lake Roland reservoirs are considered. Notes that the annual deposit of silt in Loch Raven reservoir from 1881 to 1909 is estimated at 226,000 cu. yd. Describes Whipple's estimates of turbidity conditions relative to the water to be drawn from the proposed new Loch Raven reservoir and Hazen's suggested means of removing this turbidity. Data are given on turbidities in water of the Gunpowder River at existing Loch Raven dam. Includes description of Loch Raven planting plan to furnish the new impounding reservoir with protection from erosion and silting.
- BAMESBERGER, J. G. See U. S. Soil Conservation Service, 2.
- BANKS, EDGAR J.
1. The reclamation of ancient Babylonia by irrigation. Engin. News, vol. 69, no. 10, pp. 468-469, illus., Mar. 6, 1913.
Considers the reclamation of ancient Babylonia by new construction and reconstruction of old vast irrigation projects. Agricultural decline of Babylon (about 2500 years ago) due to silting in irrigation canals is noted. Describes dam under construction on Euphrates River to carry away silt-laden spring floods thus preventing choking of smaller irrigation canals.
- BANTEL, P. A. See Taylor, T. U., 6.
- BARBER, JOHN WARNER.
1. New Haven. 593 pp., illus., 1838 (Connecticut historical collections).
Ships were built and launched where there is a meadow now at New Haven, Conn. In 1765 the wharf extended only 20 yd. from shore, but in 1838 it extended over 1,300 yd.
- BARCLAY, M. G. See Gottschalk, L. C., 12.
- BARLOW, C. G. See Jones, F. R., 1.
- BARNES, EARL E.
1. A method for the determination of size distribution in soils. Amer. Soil Survey Assoc., Rpt. 10, pp. 169-173, Mar. 1930; [abstract], Expt. Sta. Rec., vol. 66, p. 314, 1932.
Describes a method and the apparatus used, which is of the Wiegner type but has features of the Kelley apparatus.
- BARNES, FARRELL F. See also Brown, C. B., 2, 3; Eargle, D. H., 4.
1. Advance report on the sedimentation survey of Lay Reservoir, Clanton, Alabama. U. S. Soil Conserv. Serv. SCS-SS-13, 13 pp., illus., May 1937.
The survey, conducted from Jan. 27 to July 24, 1936 at Lay Reservoir, a hydroelectric development located on the Coosa River about 12 miles northeast of Clanton, Alabama, revealed that the reservoir had lost, due to silting, 11.50 percent of its capacity since its completion in December 1913. Average annual depletion amounted to 0.52 percent. Original storage capacity of 156,525 acre-feet was reduced to 138,520 acre-feet during the 22.3 years of operation. Of the total watershed area of 9,087 sq miles, 60 percent is forest, 30 percent cultivated, and 10 percent pasture. Sediment in the reservoir is derived chiefly from sheet and gully erosion on the watershed, particularly from those regions where the rate of erosion has been increased by deforestation, by burning of forest litter, and by unwise farming practices. Large quantities of sediment by-passed by the reservoir indicate that the average rate of topsoil removal is several times that indicated by the amount of sediment trapped by the reservoir. Report includes detailed data dealing with the engineering features of the dam and reservoir, also data relative to the character, distribution, and origin of the sediment in the reservoir.
2. Advance report on the sedimentation survey of Barcroft Reservoir, Alexandria, Virginia. U. S. Soil Conserv. Serv., SCS-SS-29, 13 pp., illus., Jan. 1939.
A survey made Sept. 17-Mar. 8, 1938 at Barcroft Reservoir, an 1,847 acre-feet semi-channel reserve municipal water supply reservoir on Holmes Run about 6 miles northwest of Alexandria, Va., revealed that 4.60 percent of its original capacity had been lost due to silting since its completion in January 1915, an average annual depletion of 0.20 percent. Total deposits in the reservoir amounted to 85 acre-feet after 23.1 years of operation, an average annual accumulation of 3.7 acre-feet. About half the watershed area of 14.5 sq. miles is in woods and brush, a fifth is cultivated, and the remainder is in pasture and urban areas. Deposits in the reservoir have been derived chiefly from almost imperceptible sheet erosion, particularly of cultivated areas. The report includes detailed data pertaining to the engineering features of the dam and reservoir, character of watershed, and character, distribution, and origin of reservoir deposits.
3. (and Brown, Carl B.). Advance report on the sedimentation survey of Burnt Mills Reservoir, Silver Spring, Maryland. U. S. Soil Conserv. Serv., SCS-SS-31, 14 pp., illus., Jan. 1939.
A survey conducted Feb. 22-Mar. 3, 1938 disclosed that Burnt Mills Reservoir, a channel-type water-supply reservoir located about 5

- miles north of Washington, D. C., on the Northwest Branch of the Anacostia River, had lost 47.5 percent of its original storage during 7.8 years of operation. Total sediment accumulation in the 181 acre-foot reservoir amounted to 86 acre-feet; an average annual accumulation of 11.0 acre-feet. The 27 sq. miles of drainage basin is characterized by moderately to steeply rolling topography and silt loam soils developed on granite and shist; the area is undergoing slight to moderate, and in scattered localities severe, sheet erosion; about half of the area is cultivated, the remainder about equally divided between open pasture and woodland. Includes description of method of survey and gives detailed data on the character of reservoir deposits, distribution of sediment in the reservoir, and origin of deposits. Concludes that sheet erosion is the main factor involved in the silting up of the reservoir and that the excessive rate of loss in reservoir storage capacity is due to the low ratio of reservoir capacity to watershed area; notes need for appropriate soil conservation measures on watershed areas.
4. (and Brown, Carl B.). Advance report on the sedimentation survey of Greenbelt Lake, Greenbelt, Maryland. U. S. Soil Conserv. Serv., SCS-SS-33, 12 pp., illus., Apr. 1939.
A survey of Greenbelt Lake, a recreational development, Jan. 27-Feb. 8, 1938 revealed that the reservoir lost 5.10 percent of its capacity due to silting since completion of the reservoir in July 1936. The reservoir is on a minor headwater tributary of the Anacostia River. Original capacity of reservoir was 196 acre-feet and in 1.6 years of operation 10 acre-feet of sediment have accumulated in the reservoir, an average annual loss of 6.25 acre-feet or 3.19 percent of the original capacity. Of the 530-acre drainage area, 65 percent is wooded, 27 percent urban, and 8 percent idle. Severe sheet and gully erosion on land cleared, broken up, and exposed during construction period of the Greenbelt project and in a few abandoned fields in the drainage area mainly accounts for the excessive rate of reservoir silting. Appropriate application of various erosion control measures applied to areas affected during construction of the Greenbelt project has greatly reduced washing of the soil. Maintenance of present cover conditions will reduce rate of reservoir silting. Report includes detailed data pertaining to the engineering features of the dam and reservoir, character of drainage basin, and the character, distribution, and origin of the sediment in the reservoir.
 5. (and Kraebel, C. J., and La Motte, R. S.). Effect of accelerated erosion on silting in Morena Reservoir, San Diego County, California. U. S. Dept. Agr. Tech. Bul. 639, 22 pp., illus., Dec. 1939.
Presents results of a study of erosion and reservoir sedimentation in the Morena drainage basin, California, made in 1935 cooperatively by the Soil Conservation Service and the Forest Service. Sedimentation survey (1935) of Morena Reservoir, a reserve municipal water-supply reservoir, located on Cottonwood Creek, 35 miles east of San Diego, Calif., disclosed that 10.50 percent of its original capacity had been lost due to silting since its completion in March 1910, an average annual loss of 0.41 percent. Total deposits in the reservoir amounted to 7,184 acre-feet after 25.7 years of operation; average annual accumulation of 280 acre-feet. Detailed data pertaining to the engineering features of the dam and reservoir, results of observations on the character and distribution of sediment in the reservoir and on silt underflow, estimates of average rate of degradation of the drainage basin, and the probable future trends of silting in the reservoir are given. A watershed survey revealed the nature and causes of accelerated erosion in the Morena drainage basin and the principal sources of reservoir sediment. Describes program of watershed erosion-control.
- BARNES, FRED J.
1. Sluicing silt to reduce canal leakage. Engin. News-Rec., vol. 78, no. 7, pp. 337-339, illus., May 17, 1917.
Describes experimental plant installed on main canal of Grand Valley irrigation project, Colorado, to silt bottom and reduce canal leakage. Notes observations of quantity of water and silt handled, power consumption, erection cost, operation and deterioration of plant, and velocity of canal water necessary to hold silt in suspension.
- BARNES, G. A.
1. Soil conservation in regard to water supplies in the Southwestern States [abstract]. Southwest Water Works Jour., vol. 18, no. 5, pp. 11-14, 28, Aug. 26, 1936.
Reports on the excessive silting of reservoirs of the Southwest which shows the need for adequate soil erosion-control measures. Summarizes briefly silt surveys of Lake Waco, Tex., which filled 12.38 percent in 5 yr. or at an average annual rate of 2.48 percent (March 1935); White Rock Reservoir, Tex., which filled 21.38 percent in 25 yr. or at an average annual rate of 0.85 percent (April 1935); Rogers Municipal Reservoir at Rogers, Tex., which filled 23 percent in 12 yr. or at an average annual rate of 1.9 percent (September 1934); Guthrie Reservoir at Guthrie, Okla., which filled 15.37 percent in 14.5 yr. or at an average annual rate of 1.05 percent (May 1934); Boomer Reservoir at Stillwater, Okla., which filled 7.49 percent in 10.25 yr. or at an average annual rate of 0.73 percent (June 1935); and Lake Spavinaw at Tulsa, Okla., which filled 7.72 percent in 11 yr. or at an annual rate of 0.34 percent. Describes detailed surveys of White Rock and Lake Waco Reservoirs giving location, ownership, purpose, description of dam, original storage capacity, loss of capacity due to silting, former silt surveys, area and character of watershed, mean annual rainfall, draft and history of survey. Describes the character, volume, and distribution of sediment.
- BARNES, LELAND H. See Connaughton, M. P., 4; Flaxman, E. M., 1.
- BARNES, WILL CROFT.
1. The story of the range. In U. S. Congress. Senate. Committee on Public Lands and Surveys. National forests and the public domain. Hearings, 69th Cong., 1st sess., vol. 2, pp. 1579-1640, illus., 1926.
Discusses the effect of unrestricted grazing of range lands in the United States on the forage and land, and the attempts to regulate grazing and perpetuate the natural forage resources of the open ranges. The question of erosion is considered in relation to unregulated grazing, conditions of the transportation and deposition of erosional debris in the Manti National Forest in the Wasatch Mountains in central Utah being noted.
- BARNETT, C. E. See Gamble, D. L., 1.
- BARRELL, JOSEPH.
1. Relations between climate and terrestrial deposits. Jour. Geol., vol. 16, no. 2, pp. 159-190, Feb./Mar. 1908.
Discusses the effects of climate upon conditions of erosion and fluvial and pluvial deposition.
2. Marine and terrestrial conglomerates. Geol. Soc. Amer. Bul., vol. 36, pp. 279-342, illus., June 30, 1925.
Deals with the conditions of development and distribution of gravels of marine and terrestrial origin. Includes discussion on the relation of velocity to transportation in streams, the distribution by rivers of gravel along their beds, the relations between distance and wear of gravel, the rate of wear in various river systems, the relations of ungraded stream profiles to gravel transportation, and the maximum limits of gravel transportation by streams.

BARROWS, HARLAN H.

1. Middle portion of the Illinois Valley. Ill. Geol. Survey, Bul. 8, pp. 77-80, illus., 1908.
Describes the character and nature of alluvial fans where tributaries enter the valley of the Illinois and the effect of these deposits upon certain hydraulic characteristics of the Illinois River.
2. Roosevelt Dam and the Salt River Valley. Jour. Geog., vol. 11, no. 9, pp. 272-284, illus., May 1913.
Presents a description of the Salt River Valley and of the Roosevelt Dam and Reservoir at Roosevelt, Ariz. Notes briefly that sedimentation in the lake, though rapid, is reduced since tributary slopes in the Tonto National Forest, where grazing is regulated, are timbered; that reservoir will nearly fill with sediment in 200 years; and that outlet tunnel at the south end of dam carries out some silt from the bottom of the reservoir.

BARRY, A. C.

1. Early history of Wisconsin—No. 2. Wis. Farmer, vol. 3, no. 11, pp. 208-209, Nov. 1851.
Includes a brief reference to the Mississippi River in which it is stated that at present, as well as at the time it was visited by De Soto, it is always muddy and trees and timber are continually floating down stream.

BARTEL, F. O.

1. Soil erosion and water conservation facts from the North Carolina experiment. Amer. Soc. Agr. Engin., Trans., vol. 23, pp. 9LR-10LR, illus., 1929.
Presents results of runoff and soil loss measurements from experimental plots in Piedmont, N. C. Notes briefly results of observations on the filling and erosion of two dredged creeks in Piedmont.

BARTON, A.

1. River Severn Catchment Board [abstract]. Civ. Engin. and Pub. Works Rev., vol. 32, p. 121, Apr. 1937.
Paper read before West Midland District of the Institution of Municipal and County Engineers on work carried out by the River Severn Catchment Board. Notes silting up of River Severn at Gloucester owing to generations of diurnal tides. Discusses scheme of channel widening, revetting concave bends, adding and raising flood banks, the realignment of old drainage sluices and the construction of new ones.

BARTON, EDWARD C.

1. The work of colloids in sandbank and delta formation. Geog. Jour., vol. 51, no. 2, pp. 100-112, illus., Feb. 1918.
Presents results of observations in Southern Queensland on the causes of the migratory movement of river mouths and the resulting shapes assumed by estuarial deposits. Includes discussion on the effect of the deposition of colloidal matter on the location of sandbanks and bars, the influence of crested waves on the movement of sandbanks, the factors involved in the building of spits and the consequent extension of a river bed leeward, the factors causing the secular movement of a large river estuary to windward, and the factors responsible for the maintenance of a bar in one position.

BARTRUM, J. A.

1. Erosion at Arapuni. New Zeal. Jour. Sci. and Technol., vol. 17, no. 1, pp. 391-397, July 1935.
Describes pot holes, sink holes, mutual notching of boulders, slotting of rocks by vibrating steel bars, and wave-cut benches on the shores of Lake Arapuni.

BARUS, CARL.

1. Subsidence of fine solid particles in liquids. U. S. Geol. Survey, Bul. 36, 54 pp., illus., 1886.
Discusses the mechanical conditions of subsidence, the dependence of subsidence on the molecular conditions of liquids, and the chemical effects of liquids on the subsiding solid. Results of experiments on the dependence of rate of subsidence on order of surface, concentration, and turbidity of liquids are given.

BASS, TURNER C. See also Martin, I. L., 1.

1. (and Martin, Irving L.). Erosion and related land use conditions on University Lake watershed, Chapel Hill, North Carolina. U. S. Soil Conserv. Serv., Physical Land Survey, no. 8, 16 pp., illus., 1939.

Presents results of a soil conservation survey of the watershed of University Lake, made in 1937, to obtain definite information regarding the condition of the land, which can be correlated with the reservoir survey of April 1935. A description of the area and the methods and results of surveying are given and discussed, including climate, economic and cultural development, agriculture, soil characteristics, slopes, kind and degree of erosion, and present land use. The reservoir survey indicated that in less than 3 years after the construction of the reservoir its storage capacity had been reduced by 3.34 percent; silt accumulations occupied 64 of the original 1915 acre-feet of storage space. Estimates from conservation- and reservoir-survey data indicate that 32 percent of the estimated total erosional debris from the watershed reached or passed the reservoir point in 155 years (1780-1935); the remaining material had lodged at higher elevations. Control measures that have as their object improved use of land and conservation of soil and water are discussed.

2. (and Martin, Irving L.). Erosion and related land use conditions on the Spartanburg Municipal Reservoir watershed. U. S. Soil Conserv. Serv., Physical Land Survey, no. 9, 16 pp., illus., 1940.
Presents and discusses results of a soil conservation survey made in 1937 to furnish definite information regarding the physical condition of the land in the Spartanburg Municipal Reservoir watershed as a physical basis for reorganizing land use on farms and to aid in interpreting the reservoir sedimentation survey made July 1934. A description of the area surveyed and the methods and results of the conservation survey are given, including climate, agriculture, soils, land use, and erosion. Results of the sedimentation survey indicate that the reservoir had silted 17.15 percent of its capacity by 1934, 8.2 years after its construction, an average annual loss of 2.09 percent. Estimates from conservation- and sedimentation-survey data indicate that approximately 26,665 acre-feet of soil material has been moved by erosional processes on the watershed since the period of intensive agricultural occupation began about 1800 and that during this period it is calculated that about 7,453 acre-feet of soil material has reached or passed the reservoir point; the remaining material has probably accumulated in small ponds, along stream channels as colluvial deposits on lower slopes, and as alluvial deposits on definite flood plains. The significance of physical factors in land use and control of erosion is considered.

BASSELL, BURR.

1. The San Leandro earth dam of the Oakland Water-Works. Engin. News, vol. 48, no. 11, p. 187, illus., Sept. 11, 1902.
Describes details of construction of San Leandro earth dam of the Oakland Water-Works, Calif. Notes that reservoir decreased in capacity from 5,826,000,000 gal. to 5,167,000,000 gal. in 26 years of operation due to silting; average deposit 1 ft. per annum. Notes provisions increasing height of dam to meet annual losses in capacity due to silting.
2. The Kern River Company's hydro-electric power enterprise. Engin. News, vol. 52, no. 3, pp. 55-56, illus., July 21, 1904.
Describes construction of hydro-electric plant on the Kern River in Kern County, Calif., to provide power for Los Angeles. Notes details of settling basin to hold 250,000 cu. ft. of silt below grade of canal. Wasteway provided with sluice gates for discharging sand and silt back into river channel.

BATES, C. G. See also Hoyt, W. G., 1.

1. The erosion problem. Jour. Forestry, vol. 22,

no. 5, pp. 498-505, May 1924.

- Treats the effect of erosion with respect to the influence of forests on stream-flow. Discusses effect of detrital loads of streams in increasing volume of flood at least three times, noting damage to Pueblo, Colo., and farms in Arkansas Valley after Pueblo flood. Added to the increased volume of flood by reason of silt carried is the fact that each addition of silt, sand, and gravel increases abrasive force of stream. Gives results of experiment at Wagon Wheel Gap, Colo., to determine effects of denudation on increasing stream discharge and silt load, and states that erosion has resulted not from the cutting down and burning of timber but from other mechanical operations (road building, trail washing, etc.) near the stream. Notes similar conditions on McKinney Creek and necessity for remedial measures. Discusses similarity of the effects of grazing and of road building, noting that grazing on the Tonto Forest is being reduced 50 percent in order to check erosion which is silting up Roosevelt Reservoir at the rate of 18,000 cu. yd. annually. States methods by which erosion on National Forests may be checked and damage prevented in the valleys of larger streams.
2. (and Henry, A. J.). Forest and stream-flow experiment at Wagon Wheel Gap, Colorado. *Monthly Weather Rev.*, Sup. 30, 79 pp., illus., 1928; [abstract], *Monthly Weather Rev.*, vol. 56, no. 3, pp. 79-97, illus., Mar. 1928.
- Consists of studies made by the U. S. Forest Service on two continuous watersheds, under similar conditions of forest cover, to determine the influence of forests on stream flow and prevention of soil erosion. Observations were made for a term of 8 yr. on meteorological conditions and stream flow, then one watershed was denuded of timber and measurements for a period of 7 yr. were made. Silt load of the stream in the denuded area was increased 5-15 times with 50 percent increase in flood crests, increased runoff, and increased discharge ratio. Discusses application of these results to other regions, types of soil, and conditions of climate.
3. (and Zeasman, O. R.). Soil erosion—a local and national problem. *Wis. Agr. Expt. Sta., Res. Bul.* 99, 100 pp., illus., Aug. 1930.
- Reports the investigation of soil erosion made by the Wisconsin Agricultural Experiment Station in cooperation with the Lake States Forest Experiment Station of the U. S. Forest Service. The area studied includes three counties in the unglaciated section of southeastern Wisconsin, and a small part of Minnesota near Winona. Presents data on silt loads carried by streams from July to October 1929 in order to estimate the total erosion and silt contribution to the Mississippi River from southwestern Wisconsin. Considers the significance of erosion in southwestern Wisconsin with reference to the silting problem of the Mississippi.
4. Chaining the Father of Waters. *Amer. Forests*, vol. 37, no. 2, pp. 67-70, 106, 127, illus., Feb. 1931.
- The conditions of soil erosion and the resultant silt problem in the Mississippi Valley, with particular reference to areas in southeastern Minnesota and southwestern Wisconsin are given. Despoilation of streams by silt is a symptom of soil erosion. Sediment determinations (1929-30) of stream waters indicate that an estimated 25,000,000 cu. yd. of silt, derived mainly from cultivated areas, are annually washed into the Mississippi from areas draining into that section of the river from the Chipewewa to the Wisconsin Rivers. Conditions of sediment transportation as bed and suspended loads in the Mississippi and its tributaries are considered. Discusses the effect of the sediment load of streams upon flood control and navigation. Stresses the importance of soil conservation and erosion control practices on stream watersheds as flood control measures.
5. The forest influence on streamflow under divergent conditions. *Jour. Forestry*, vol. 34, no. 11, pp. 961-969, Nov. 1936.
- Deals with erosion conditions in southwestern Wisconsin and adjacent Minnesota with comparison to standards set up by Wagon Wheel Gap stream-flow experiment in Colorado. Notes briefly that total silt load of Gilmore Creek during the flood of July 21, 1933 amounted to about 32,000 tons, or about 75 percent of the estimated average annual yield for this watershed.
6. [Summary of] Reforestation and flood control. *Jour. Forestry*, vol. 36, no. 10, pp. 1073-1079, Oct. 1938.
- Deals with various aspects of the effects of reforestation upon floods, particularly in the watershed of the Root River, Minn. Includes one paragraph commenting on the silting of a proposed reservoir on Root River, noting that the estimated rate would annually amount to 1,200 acre-feet or 0.6 percent of the reservoir capacity.
- Discussion: A. H. RICHARDSON, pp. 1080-1081, describes conditions of and damages due to floods of the Grand River, Ontario, Canada, and land use. Comments upon differences of opinion regarding proper land use in connection with flood control, and quotes C. C. Chambers (Muskingum Watershed Conservancy District) on the value of reforestation as a means of, among other things, preventing the silting of reservoirs.
- BATES, E. M.
1. Regrassing silted areas. *New Zeal. Jour. Agr.*, vol. 56, no. 5, pp. 314-318, illus., May 20, 1938.
- Comments on methods of sowing grass seed on freshly silted pasture land in New Zealand and Australia with silt thickness varying from light dressing to 5 ft. Following floods of 1932 and 1938 in the Poverty Bay area, 60 percent of the area silted was resown by hand as soon as flood waters subsided. Prompt sowing is essential because of the rapid drying of silt. Same procedure must be followed in Hawke's Bay area after the 1938 flood except that less time can elapse between silting and sowing.
- BATES, ROBERT E.
1. Geomorphic history of the Kickapoo Region, Wisconsin. *Geol. Soc. Amer. Bul.*, vol. 50, no. 6, pp. 819-880, illus., June 1, 1939.
- Deals with the geomorphic development of the Kickapoo Region, Wis. Discusses the causes and limits of meander growth in streams and the connection between stream size and the size of meanders.
- BAUDER, H. A. See Campbell, F. B., 2.
- BAUER, EDWARD E.
1. Hydrometer computations in soil studies simplified. *Engin. News-Rec.*, vol. 118, no. 18, pp. 662-664, illus., May 6, 1937.
- In order to reduce the amount of computation necessary in an analysis using the density hydrometer, tables are presented for the portions of the formulas which are functions of known physical data. Notes two types of hydrometer, one developed by Bouyoucos and the other by A. Casagrande.
2. A study of deflocculating agents used in the particle size determination of soils. *Amer. Soc. Testing Mater.*, vol. 38, pt. 2, pp. 575-586, illus., 1939.
- Presents the various phases of the whole problem of deflocculation. Gives various conclusions regarding the use of deflocculating agents and methods, mainly related to soils.
- BAUER, S. G. See Griffith, W. M., 2.
- BAUM, L. A. H. See Traxler, R. N., 1.
- BAUMANN, PAUL.
1. The function and design of check dams [abstract]. *Civ. Engin.*, vol. 6, no. 6, pp. 355-358, illus., June 1936.
- An address before the Progressive Conference on Water Conservation, Los Angeles, 1935. Discusses check dam systems to stabilize stream beds, and side slopes, and to insure against floods by retaining flow causing deposition of sediment and raising of stream bed. Velocity is thereby decreased reducing scour. Notes ten useful rules for the design of check dams.
2. The debris problem in flood control. *Engin. News-Rec.*, vol. 132, no. 2, pp. 78-81, Jan. 13, 1944.

- Gives design data for California debris dams, methods of removing silt, sluicing operations, 1941-43, and effect of sluicing on channels below dams. Includes a table giving quantities of debris moved and cost of sluicing operations, 1941-43, of Big Tujunga, Eaton, Devil's Gate, Sawpit, Sierra Madre, Big Santa Anita, and San Gabriel No. 2 Reservoirs.
 3. Control of flood debris in San Gabriel area. *Civ. Engin.*, vol. 14, no. 4, pp. 143-146, illus., Apr. 1944.

Describes the work of the Los Angeles County Flood Control District in the San Gabriel area of California which is concerned with the control of floods which carry enormous quantities of debris. Considers the use of check dams for erosion control.
 4. Devil's Gate Dam - sluiceway driven through structure. *West. Construct. News*, vol. 19, no. 11, pp. 67-69, illus., Nov. 1944.

Describes a sluiceway to prevent silting in Devil's Gate Dam, a Los Angeles County flood control dam.
- BAY, H. X. See Tester, A. C., 2.
- BEACH, LANSING H. See also Mead, E., 5.
1. The work of the Corps of Engineers on the lower Mississippi. *Amer. Soc. Civ. Engin., Trans.*, vol. 87, pp. 972-978, 1924.

Reviews the work done by the U. S. Corps of Engineers on the lower Mississippi; notes various improvements completed and plans for the regulation of the Mississippi. Considers work completed by the U. S. Mississippi River Commission.

Discussion: J. A. OCKERSON, pp. 1098-1100, outlines the history, studies, and objectives of the U. S. Mississippi River Commission. Reviews briefly observations by the Commission on bank caving, revetment works, levee construction, etc. SIDNEY F. LEWIS, pp. 1100-1102, states that much of the sediment in the Mississippi River is said to come from the Missouri River and that a large portion is attributed to the caving banks in bends below Cairo, Ill. Notes the need for a complete levee system augmented by protective bank revetments. W. G. PRICE, pp. 1102-1103, presents results of data obtained from studies of engineering works on the Mississippi River. Suggests that a successful plan to utilize drift material could be developed to protect river banks from erosion.
- BEARDSLEY, J. W. See Todd, O. J., 10.
- BEAVERS, ELLINGTON M.
1. A tube for studying dilute sediments. *Textile Res.*, vol. 10, no. 7, pp. 280-286, May 1940.

Discusses a modified Kelly tube developed for studying rate of settling of fine particles in dilute suspensions. Describes the apparatus and presents a general equation which permits direct calculation of percent of material settled. Gives experimental results for settling of barium sulfate suspension.
- BEBOUT, G. B.
1. Silt movement at river bends [letter to editor]. *Civ. Engin.*, vol. 3, no. 8, p. 471, Aug. 1933.

Approves theory in *Flow in River Bends* (Vogel, H. D., 3). Considers nature of turbulence and means for determining its relative degrees. Difference in velocity head of individual parallel filaments causes pressure differential to move bed load toward zone of lower pressure (velocity). By this means, particles are held in suspension and not by upward component of velocity as previously held.
- BECKMAN, H. C.
1. Water resources of Missouri, 1857-1926. 424 pp., illus. Rolla, Mo. Bur. Geol. and Mines, 1927.

Results of chemical analyses of 206 samples of surface waters from various rivers and springs are included. Gives data on turbidity, coefficient of fineness, and dissolved and suspended load determinations.
- BECRAFT, R. J. See Bailey, R. W., 1.
- BEEMAN, NORVIL.
1. Effect of hydrogen-ion concentration upon the sedimentation of clay. *Amer. Ceramics Soc., Jour.*, vol. 14, no. 1, pp. 72-87, illus., Jan. 1931.

Notes that the addition of an acid to a clay suspension causes rapid sedimentation and a base causes slow sedimentation. Presents experiments which show the effect of the hydrogen-ion concentration upon sedimentation rate and that elutriation is uncertain without pH control.
- BEGLAR, J. D.
1. River changes in Bengal. *Indian Engin.*, vol. 4, no. 23, pp. 455-456, Dec. 8, 1888.

Deals with the mutual influence of the rivers Hooghly, Damuda, and Rupnarayan on the formation of deposits which endanger the Port of Calcutta, India, and presents a proposed scheme to ameliorate existing conditions.
- BEHRE, C. H., JR.
1. Sand flotation in nature. *Science*, n. s., vol. 63, no. 1633, pp. 405-406, Apr. 16, 1926.

Discusses experiments concerned with the flotation of sand particles as a special surface tension phenomenon.
- BELL, G. J. See Blaess, A. F., 1.
- BELL, HUGH STEVENS. See also Bailey, R. W., 4; Stevens, J. C., 6; Witzig, B. J., 1.
1. Armored mud balls - their origin, properties, and role in sedimentation. *Jour. Geol.*, vol. 48, no. 1, pp. 1-31, illus., Jan./Feb. 1940; and in *Soil Conserv.*, vol. 5, no. 12, pp. 288-289, 308, illus., June 1940.

Reports a field and laboratory investigation regarding the origin and properties of mud balls and their importance as a factor in the transportation of erosional debris. Summarizes previous literature, noting observations on occurrence of mud balls, ideas regarding their origin, and factors limiting their size. Mud balls for study were supplied by Las Posas barranca between El Rio and Camarillo, Calif. They were formed by the stream during the flood of March 1938. The extent of flood damage is noted. Discusses the size which balls may attain, considering the relationship between forces of cohesion and impact; the rolling process of sediment transportation as essential to the formation of clay balls with high sphericity; the relationship between sphericity and the distance mud balls travel; and armored mud balls, including the influence of weight, sphericity, and specific surface upon armor quantity. Consideration is given to mud balls as agents for the transportation of erosional debris as bed load and as agents in gully formation. Conditions of deposition are noted.
 2. Some evidence regarding the kind and quantity of sediment transported by density-currents. *Amer. Geophys. Union, Trans.*, vol. 23, pt. 1, pp. 67-73, 1942.

Points out that both aqueous and atmospheric density currents transport enormous quantities of fine sediment and that data are not adequate for making other than rough estimates of the amount transported. Material deposited by density currents is well sorted, atmospheric deposits being coarser than aqueous. Shows the need for data such as that gathered at Lake Mead. States that aqueous density currents distribute sediment that occupies valuable space in reservoirs, lakes, and harbors; and notes that because of this and other reasons it is desirable to obtain a more thorough knowledge of them.
 3. Density currents as agents for transporting sediments. *Jour. Geol.*, vol. 50, no. 5, pp. 512-547, illus., July/Aug. 1942.

Defines density currents, and discusses their origin, driving mechanism, and characteristic behavior. Shows that "black blizzards," underflows of turbid water, and "nuées ardentes" have much in common. Calls attention to the marked difference in coarseness of sediments transported by atmospheric and aqueous density currents. Discusses briefly the effect of flocculation upon density currents. Gives estimates as to the quantity of fine sediment transported by turbid density flows at Lake Mead, by the atmosphere following volcanic eruptions, and by major dust storms.
 4. Stratified flow in reservoirs and its use in preven-

tion of silting. U. S. Dept. Agr., Misc. Pub. 491, 46 pp., illus., Sept. 1942; [abstract], Amer. Water Works Assoc., Jour., vol. 36, no. 1, pp. 109-110, Jan. 1944.

Consists of an introduction to density currents. Defines them, and describes their behavior and characteristics. Factors governing the withdrawal of fluid layers from reservoirs are listed. Presents data on the quantity of sediment transported by density currents. Suggests possible uses of density currents, paying particular attention to their possible use in the more efficient operation of reservoirs.

5. The effect of entrance mixing on the size of density currents in Shaver Lake. Amer. Geophys. Union, Trans., vol. 28, no. 5, pp. 780-791, Oct. 1947. Discusses results of field studies on entrance mixing and data obtained during June 1944 at Shaver Lake, California. Studies were undertaken to determine the order of magnitude of entrance mixing. Summarizes the results of the study.

BELLASIS, EDWARD SKEFTON. See also Griffith, W. M., 1.

1. Some problems in hydraulics and river engineering. Engineers [London], vol. 142, no. 3684, pp. 202-203, illus., Aug. 20, 1926.

Discusses several engineering questions which have arisen regarding the construction of the proposed Sukkur Barrage; includes comments on changes in rivers in alluvial plains in connection with the problem as to whether the barrage will tend to increase the danger of the Indus taking a new course and abandoning the Sukkur Gorge, and silt and scour in the Indus in connection with possible silt deposits in canals.

2. River and canal engineering. Ed. 3, 373 pp., illus. London, E. and F. N. Spon, Ltd., 1931.

A book on river and canal engineering, a branch of engineering which deals with characteristics and tendencies of streams flowing in open channels and methods used in works designed to control, store, or utilize waters of streams. Discusses various types of works used in stream control. Discusses the transportation of silt, quantity of suspended silt in rivers, silting and scouring action, stream-bank erosion, bank protection, and works for the control of silting and scouring action.

3. Flow in open channels. Indian Engin., vol. 103, no. 4, pp. 135-136, Apr. 1938. Discusses Gerald Lacey's diagram and formulas. Gives a table made from Kutter's and Kennedy's figures for regime irrigation channels.

BENEDICT, PAUL C. See also Love, S. K., 3, 5; Nelson, M. E., 2; Stevens, J. C., 6; U. S. Interdepartmental Committee, 10.

1. Preliminary field tests of the US sediment-sampling equipment in the Colorado River basin. 10 pp., illus. Iowa City, Iowa, U. S. Geol. Survey, 1944.

Presents results of preliminary field tests of sediment-sampling equipment developed at Iowa City at stations in the Colorado River Basin. Comparative tests were made with sediment samplers in use in the Basin; results obtained with the US D-43 and brass pipe samplers were compared with results obtained with the Colorado River sampler. Gives comparison of results obtained with the US D-43 and P-43 sediment samplers. Points out that the results of the preliminary field tests verify the conclusions reached in the study of sampler entrance conditions at the Hydraulics Laboratory of the Iowa Institute of Hydraulic Research.

2. A study of the errors resulting from the use of turbidity in computing the suspended sediment discharge of Iowa streams. Iowa Acad. Sci., Proc. (1945), vol. 52, pp. 205-210, illus., 1946.

Describes studies made at the University of Iowa by the U. S. Geological Survey to determine the relationship between turbidity and suspended sediment concentration. Notes that the indiscriminate use of turbidities in determining sediment concentrations in Iowa streams appears extremely variable; this is

due in part to lack of a definite relation between turbidity and suspended solids or to the methods and equipment used in the sample collecting.

3. Determination of the suspended sediment discharge of streams. Fed. Inter-Agency Sedimentation Conf., Denver, 1947, Proc., pp. 55-65, illus., 1948. Reviews the use of various types of samplers, sampling installations, techniques, and method of computation used by the Geological Survey in determining suspended sediment discharge. Discusses the factors affecting the concentration of suspended sediment in a stream.

Discussion: R. J. PAFFORD, JR., pp. 65-67, states the techniques and equipment used by the Corps of Engineers in the Missouri River Basin for suspended-load determination. Mentions the value to engineers of determining suspended sediment-load particle-size gradation.

BENGAL, AGRICULTURAL CHEMIST.

1. Annual report...for the year ending 31st March 1936. Bengal Dept. Agr. Ann. Rpt. 1935/36, pt. 2, pp. 53-96, 1936.

Conclusions from experiments on the fertility of Damodar Canal silt are given (pp. 58-59).

BENNETT, CHARLES S. See also Vogel, H. D., 8.

1. Hydrological data from the Miami Conservancy District. Engin. News-Rec., vol. 113, no. 18, pp. 556-558, illus., Nov. 1, 1934.

Deals with hydrological and meteorological data, river channel roughness coefficients, and silt deposition in retarding basins of the Miami Conservancy District flood control project between 1922 and 1933. Channel cross-section was surveyed every 2 years showing an accretion in 10 years of 500,000 cu. yds. in 1 1/2 miles of channel at Hamilton. Value of river flow coefficients n (Kutter) before and after silting and subsequent removal of silt by dredging is given. Silt catching boxes 12 in. x 12 in. x 6 in. of special design were installed at various elevations in Germantown and Englewood Reservoirs in 1927. Deposition in boxes indicates that quantity of silt varies not only with flood duration but also with season of year in which flood occurs, being greatest during growing season when land is under cultivation. Cross section 800 ft. above Germantown Dam indicates a maximum silt deposit of 3.0 ft. in six years.

BENNETT, HUGH HAMMOND.

1. (and Chapline, W. R.). Soil erosion a national menace. U. S. Dept. Agr. Cir. 33, 36 pp., illus., 1928.

Pt. 1, Some aspects of wastage caused by soil erosion, by H. H. Bennett, deals with the evils of the working processes of land wastage, stressing the need for increased practical information and research work relating to the problem; discusses plant-food wastage through erosion; giving data on annual discharges of sediment to the sea by rivers; cites instances of accelerated erosion, and conditions of stream and valley deposition; discusses the relation of sediments to fertility; considers the relation of soil erosion to flood control; and notes the complete filling with erosional debris of the Harding Reservoir during the flood of November 1926 due to removal of forest cover by fire during the previous month. Pt. 2, Soil erosion on western grazing lands, by W. R. Chapline, deals with the importance of forest cover as a protection against the menace of soil erosion, including a discussion on the silting of reservoirs; notes that silt in Elephant Butte Reservoir is reducing its capacity at the rate of 0.7 percent per year; and describes briefly conditions of silting in the Roosevelt Reservoir.

2. Studies on soils which bear on sedimentation. Natl. Res. Council, Reprint and Cir. Ser. 85, pp. 80-83, 1928.

Describes results of laboratory studies of the Bureau of Chemistry during 1917 on the susceptibility of various soils to erosion, giving physical characteristics and chemical constituents of the Nipe clay (eastern Cuba), Aiken clay loam (western Oregon), Memphis silt loam

- (near Vicksburg, Miss.), and Orangeburg fine sandy loam. Notes that Memphis silt loam is exceedingly silty (containing 70 percent or more of silt particles) and highly erodible. Silt particles are easily placed in suspension and settle out slowly, indicating a high degree of dispersion. Discusses effect of highly erosive soils on agricultural lands of stream bottoms damaged by deposits of inert sand and clogging of watercourses (northeastern Mississippi and northern Doniphan County), noting extent of erosion in a small valley, and deposition in Missouri River bottoms of northern Doniphan County. Conditions of gulying in the Trans-Pecos region of Texas resulting in the entrance of large quantities of silt into the Rio Grande are briefly described. Notes results of small erosion surveys at Spur Substation of Texas Agricultural Experiment Station and near Raleigh, N. C., giving evidence of deposition.
3. Soil erosion and flood control. Lectures before the U. S. Dept. Agr. Graduate School, Lecture I, 16 pp., Jan. 30, 1928. (SCS-TP-7)
Discusses causes, amounts, and effects of erosion in different parts of the United States. Includes information on amount of silt discharge in various drainage basins and fertilizing value of erosional debris. Gives examples of sedimentation in Doniphan County, Kans., in the Santa Clara River Valley, Calif., in New England, and in other sections of the country.
 4. Erosion and flood control. Lectures before the U. S. Dept. Agr. Graduate School, Lecture II, 15 pp., Feb. 1, 1928. (SCS-TP-7)
Discusses the most important erosional variants which are soil character, disturbance of vegetative cover, disturbance of ground equilibrium, degree of slope, and climate. Gives correlations between amount of suspended material and climatic and soil conditions. Suspended matter in loessial regions exceeds that in glacial regions by 158 times while dissolved matter of the former exceeds that of the latter by 5 times. Compares soils and suspended matter in Missouri, Santee, Cape Fear, Rio Grande, and Sacramento River Basins.
 5. Utilization of small water powers. Soil Conserv., vol. 2, no. 4, pp. 74-80, Oct. 1936.
Deals with the use of little waters and small water powers. Gives data on water power utilized in the United States and comments on the filling of reservoirs with silt in the Piedmont. Tables show number of reservoirs surveyed by the Soil Conservation Service, 1934 to 1936. Notes silting records of reservoirs of higher capacity-inflow ratio such as White Rock, Elephant Butte, Roosevelt, Lake Mitchie, Lake Worth, Lake McMillan, Zuni, Sweetwater, Lake Cabot, and Gibraltar. Data are also included for the reservoirs in the Piedmont and southern Appalachian Mountain region.
 6. Soil conservation. 993 pp., illus. New York, McGraw-Hill Book Co., 1939.
Deals with the processes of soil destruction, the consequences of the erosion processes, and the problem of erosion control in the United States. Includes discussions on the as-sorting effect of water on solid suspension; conditions of sediment transportation and deposition; vegetative changes due to silting; effect upon vegetation of lowering of water table due to channel erosion, and effect of overwash on vegetation; sediment load of streams; reservoir silting; source of reservoir silt; stream and valley sedimentation; and correlation of sediment data with watershed conditions.
 7. Some relations of soil conservation to rivers and harbors. 10 pp. Washington, U. S. Soil Conserv. Serv., 1941.
Address at special session of National Rivers and Harbors Congress, Miami, Fla., Nov. 14, 1941.
Stresses the seriousness of the erosion and sedimentation problem and describes the work of the U. S. Soil Conservation Service in combatting the causes and effects of accelerated erosion in the United States. Notes conditions of sedimentation in the Coldwater and Tallahatchie Rivers; causes and conditions of stream and valley sedimentation in the Grand River basin, Mich.; and tree planting and dredging operations for channel maintenance and for the protection of Grand Haven harbor; causes and conditions of stream and valley sedimentation and erosion-control work in the Colma Creek basin, San Mateo District, Calif.; rate of silting per acre of watershed in reservoirs of the East Bay Municipal Utility District, Calif. and erosion-prevention work in the District; and effect of erosion control measures in reducing the rate of silting in the High Point municipal reservoir, N. C. Stresses the beneficial effects of cooperative erosion-control practices carried out by soil conservation districts in the United States.
 8. Stream pollution by erosion silt. In Cong. House Com. on Rivers and Harbors. Pollution of navigable waters. hearings...79th Cong., 1st sess. on H. R. 519, H. R. 587, and H. R. 4070, pp. 318-327, Washington, 1946.
Discusses the work of the U. S. Soil Conservation Service in combatting erosion-produced silt. Comments on the effects of silt pollution on public health, water supply, fisheries, valley agriculture, irrigation, flood control, commerce, recreation, and power production. Deals with the results of soil conservation on watersheds. Treats briefly the effect of soil conservation measures in the reduction of sediment deposition in a municipal water supply reservoir at High Point, N. C., and effects of soil conservation work on the watershed of Gilmore Creek near Winona, Minn.
- BENTON, SIR JOHN.
1. Silting operation: report...on Sangla Silting Reaches, Rakh Branch, Second Division, Chenab Canal—Dated 30th August 1897. Punjab Public Works Dept., Irrig. Branch, Papers 5, pp. 25-31, illus., n. d.
Considers the circumstances which led to construction of silting reaches. Deals with the general problems of reaches, noting silt deposition and the duration of silting long reaches.
 2. The Punjab triple canal system [abstract]. Engineering, vol. 100, p. 515, Nov. 19, 1915.
Gives brief summary of design of works in which trial bedlines were run to secure non-silting channels as given by the Kennedy formula for critical velocity. Side berms used and banks set back to cause nature to eventually construct double width of banks following the principle that properly designed canals carrying sediment will silt up to 1/2-1 side slopes starting from constructed bed widths. Mechanically operated steel gates, brought well forward to leave no spaces for silt banks to form, and cisterns were provided to obviate wear of masonry floors.
- BENTZEL, CARL E. See also Kramer, H., 2.
1. Tilting glass flume demonstrates value. Civ. Engin., vol. 5, no. 6, pp. 357-360, illus., June 1935.
Describes model studies on bed-load movement with tilting glass flume at U. S. Waterways Experiment Station, Vicksburg, Miss. Studies (1933-34) made on depth, slope, water temperature, area of flow, velocity, and their effect on rate of bed-load movement. Notes studies (May 1935) to determine effect of size and distribution of sand grains on size of bed ripples and studies relative to scouring below shallow submerged sill, a condition which exists on South Pass of Mississippi River. Notes studies with sediment trap for quantitative determination of bed-load movement and effect of turbidity of water on bed-load movement.
- BERESFORD, J. S. See Buckley, A. B., 1.
- BERG, ERNEST.
1. A method for the mineralogical fractionation of sediments by means of heavy liquids and the centrifuge. Jour. Sedimentary Petrology, vol. 7, no. 2, pp. 51-54, illus., Aug. 1937.
Deals with a method of fractionation of sediments by the use of heavy liquids and the centrifuge. Describes a pipette designed by the writer.

BERG, GILMAN A.

1. Notes on the dielectric separation of mineral grains. *Jour. Sedimentary Petrology*, vol. 6, no. 1, pp. 23-27, illus., Apr. 1936.

Tabulates the dielectric constants of 38 minerals. Indicates that best results are obtained by using an ordinary 660-cycle alternating current stepped up to 880 volts.

BERGER, L. G. DEN.

1. (and Weber, F. W.). Water and silt studies of different rivers of Java. *Dutch East Indies, Alg. Proefsta. v. Landb., Meded.* 39 pp., 1919; [abstract], *Expt. Sta. Rec.*, vol. 42, no. 5, pp. 421-422, Apr. 1920.

Gives results of studies on the composition of river waters of Java, effect of dissolved constituents upon flooded soils, silt determinations, chemical and mechanical analyses of the silt, and effect of chemical and physical properties of silt upon flooded soils.

BERKEY, CHARLES P. See also Sibert, W. J., 1; Stevens, J. C., 6.

1. Critical geologic features of the Hoover Dam site [abstract]. *Science*, vol. 75, no. 1951, pp. 545-546, May 20, 1932.

Paper presented at the Washington meeting of the National Academy of Sciences Apr. 25-27, 1932, discussing special geologic requirements at the Hoover Dam site. Notes critical features connected with the impounded water and its delivery such as accumulation of silt in the reservoir, contamination of water from salt deposits of the basin, and obstruction of flow in the All-American Canal from shifting sands of the dune belt.

BERMAN, HARRY. See Larsen, E. S., 1.

BERMEL, KARL J. See also Putman, J. A., 1.

1. (and Sanks, Robert L.). Model study of Brown Canyon debris barrier. *Amer. Soc. Civ. Engin., Trans.*, vol. 112, pp. 999-1014, illus., 1947.

Deals with hydraulic tests of a 1:50 scale model of a debris barrier and the contiguous channel. To reduce the rate of silting of Devils Gate Reservoir and to control flood damage along the stream, four debris barriers have been contemplated. This study considers the Brown Canyon barrier located in the Arroyo Seco watershed in southern California as it is effected by the detrital material impounded upstream from the barrier, the scour from downstream, and the upstream deposition from the barrier. After completion of the prototype structure, results were verified by use of data obtained from the first major storm.

Discussion: CLIFFORD A. BETTS, p. 1015 comments on the problems concerned with bed load and detrital slopes upstream of the barrier. ROGER E. AMIDON, pp. 1015-1016, notes the problem of debris slopes and importance of determining the volume of slope storage.

ETTORE SCIMENI, pp. 1016-1019, treats the problem of scour at the foot of a spillway dam and considers the relation between depth of scour and grain size. J. W. JOHNSON, pp. 1019-1021, deals with the problem of sediment deposition. Gives a figure which shows relationship between annual depletion of reservoir capacity and capacity-watershed-area ratio for various reservoirs in southern California. THE AUTHORS, pp. 1021-1022, consider various comments made by the discussors.

BERRY, NARENDRA K. See Golze, A. R., 1.

BERRY, WILLIAM H. See Senour, C., 3.

BERTHOLF, W. E., JR. See also Rittenhouse, G., 7.

1. A new centrifuge tube for heavy mineral separation. *Jour. Sedimentary Petrology*, vol. 10, no. 2, p. 94, Aug. 1940.

Describes design and operation procedure of a centrifuge tube for heavy mineral separation.

BERTHOUD, E. L.

1. What shall we do for the forest - an object lesson of forest destruction. *Forester*, vol. 5, no. 6, pp. 129-130, June 1899.

Describes the effects of forest destruction on the regimen of waterflow in the streams of Jefferson County, Colo., and of denudation upon

conditions of transportation and deposition of erosional debris. Effects of the storm of July 24, 1894 in Jefferson County are noted.

BESLEY, F. W.

1. Forest planting for watershed protection. *Md.-Del. Water and Sewerage Assoc., Proc.* 7, pp. 89-96, 1933; [abstract], *Water Works and Sewerage*, vol. 80, no. 6, p. 206, June 1933.

Describes the beneficial effects of forest cover for soil and water conservation. Considers the effect of watershed protection by forest cover in the prevention of reservoir silting. Notes that the reservoir on the Patapsco River near Ilchester almost completely silted in 10 yr., Morgan Falls Plant on the Chattahoochee River silted completely in 10 yr., and Mathis Reservoir, above which is a forested area, shows little or no silt after 10 yr. of service. Notes the advantages of planting along the edges of reservoirs to prevent bank erosion.

Discussion: J. C. BRUCE, pp. 96-97, notes that the total silt in the bottom of the reservoir on Evitts Creek, Cumberland, Md., was only about 2 in. in 17 yr. because of forest cover on the watershed which prevented erosion. Describes briefly the program of reforestation on the lumbered-over portion of the watershed.

BESSON, FRANK S., JR.

1. Asphalt revetments tested by floods of two seasons. *West. Construct. News*, vol. 14, no. 4, pp. 128-130, illus., Apr. 1939.

Treats the use of asphalt revetments as bank protection on the Willamette River, Oreg. where they were found to be economical and durable.

BETTS, CLIFFORD A. See Bermel, K. J., 1.

BEURLE, C.

1. Die Verlandung des Stausens "Steyrdurchbruch" (siltation of the reservoir "Steyrdurchbruch"). *Internatl. Commun. Cong. Large Dams*, 2(1936), vol. 5, pp. 153-167, 1938. In German. Translation on file at the U. S. Soil Conservation Service, Washington, D. C.

Presents the results of sedimentation surveys of Steyrdurchbruch Reservoir on the Steyr River in upper Austria. Surveys were for the periods 1908-20, 1920-31, 1931-33, and 1933-35. During the period 1908-35 (26.5 yr.) the reservoir capacity was reduced from 845,000 cu. m. to 80,000 cu. m. Data are given on watershed characteristics, specific erosion, characteristics of sediment, deposition in channel above reservoir, and precipitation and runoff.

BHARADWAJ, B. M.

1. Prevention of silt deposition in channels. *Indian Engin.*, vol. 106, no. 1, pp. 28-29, illus., July 1935. An article relative to the prevention of silt deposition in irrigation channels in India. Silt control is effected either by diminishing the quantity of silt entering the channel by the employment of some device, or by maintaining sufficiently high velocities to carry all suspended silt to outlets, or both. A prevalent practice in the Punjab is the use of vanes and tunnels constructed above the head regulator to exclude heavier silt, which is suspended in lower layers of water, from entering the channel. Describes design and method of operation of divide wall used in combination with tunnels to regulate the entry of excessive silt into channels.

BIDDLE, S. B., JR.

1. (and Klein, Alexander). A hydrometer method for determining the fineness of Portland-Puzzolan cement. *Amer. Soc. Testing Mater., Proc.*, vol. 36, pt. 2, pp. 310-324, illus., 1937. Reviews the theoretical considerations in particle-size determinations by the hydrometer method. Describes the procedure used in testing and calculating. The use of the hydrometer method in analyzing Portland-Puzzolan cements is dealt with.

BILLINGSLEY, J. W. See Phillips, H., 1.

BIRKINBINE, H. P. M.

1. The Schuylkill River [letter to editor]. *Franklin Inst. Jour. (ser. 3)*, vol. 71, no. 5, pp. 321-324, May 1876.

BIRKINBINE, H. P. M. - Continued

Summarizes results of Schuylkill River investigations on the relationship of rainfall to stream flow and discusses the utilization of available water power at Fairmount, Pa. A summary of results of hydrographical surveys made at Fairmount Dam in the years 1861-64, and 1866 is given. Included are estimates of the accumulation of deposit in the lower portion of the Fairmount pool.

BIRRELL, D. V. C. See Einstein, H. A., 11.

BISHOP, DANA L.

1. A sedimentation method for the determination of the particle size of finely divided materials (such as hydrated lime). U. S. Bur. Standards Jour. Res., vol. 12, no. 2, pp. 173-183, illus., Feb. 1934.

Discusses a comparison between a sedimentation method of determining particle-size distribution and a microscopic method. Notes that the microscopic and sedimentation methods showed similarly shaped distribution curves with some variation.

BISSCHOP, PHILIP R. R. See Stevens, J. C., 2.

BISSELL, C. A.

1. Silt conditions at Elephant Butte Reservoir. New Reclam. Era, vol. 21, no. 10, pp. 198-199, Oct. 1930.

Deals with silt and flood conditions in the Rio Grande drainage basin in New Mexico particularly in Elephant Butte Reservoir, Puerco River, and Rio Grande, during the flood of September 1929. Only summer floods of short duration in central New Mexico are heavily silt-laden. Remaining runoff in the basin is quite clear. These summer flood waters are not usually needed for irrigation and storage. If silt retention works could be built for this 10 percent of the total runoff which might be found to carry 90 percent of the silt, the project would be greatly benefited. Average silt load of the Rio Grande at San Marcial, N. Mex. and in water entering the reservoir is 1.65 percent. The record flood in 1929 doubled the silt inflow to the reservoir. Includes table of total flow of Rio Grande at San Marcial, N. Mex. and amount of silt transported from 1926-1929.

BISSELL, MALCOLM H.

1. On the use of the terms "denudation," "erosion," "corrosion," and "corrasion." Science, n. s., vol. 53, no. 1374, pp. 412-414, Apr. 29, 1921.

Discussion on use of certain terms in geological literature. Notes confusion in use of terms—corrasion, abrasion, corrosion, erosion, and denudation; cites several authors to show wide divergence in meanings given these words. Suggests an international congress of geologists to establish precise definitions of the terms mentioned.

BIXBY, WILLIAM H. See Craighill, W. P., 1.

BLAAUW, GEERT.

1. Tidal river silt movements from Rotterdam to the sea. Engin. News-Rec., vol. 113, no. 20, pp. 623-625, illus., Nov. 15, 1934.

Comments on the estuaries of the Maas River at Rotterdam and on studies over a period of 10 yr. of the movement of silt with the incoming and outgoing tide. The futility of dredging to keep the river open to navigation having been established, the use of submerged spur dikes proved to offer a solution. The use of dikes to direct the tidal cross currents outside the estuary in such a manner as to prevent the silt-loaded salt water from flowing back up the estuary is suggested. The troublesome silt deposits are due to deposition by flocculation in the zone of the mixing of fresh and salt water. The zone of mixing moves back and forth with the tide and is subject to the phenomena of an underflow of salt water.

BLACK, MAURICE. See Hatch, F. H., 1.

BLACK, R. F.

1. (and Yeo, Herbert W.). Improvement of the Rio Grande in Socorro County, New Mexico. N. Mex., Engin. Dept., Bienl. Rpt. (1928/30), no. 9, pp. 239-296, illus., 1930.

Deals with the improvement of the Rio Grande in the Socorro County, New Mexico, with particular reference to flood control. Discusses

Rio Grande Valley floods of August and September 1929; flood damages and conditions of erosion and the deposition of silt and erosional debris; San Antonio River control works; bank protection by use of current retards to induce sedimentation; work of repairing breaks and cleaning silt and sand from heading of Luis Lopez Ditch; possibility of reclaiming swampy undeveloped lands between ditches and the A. T. & S. F. Ry. in the Socorro Valley by building up land with fertile silt to be sluiced from ditches.

BLACK, WILLIAM MURRAY. See Engels, H., 1; Ripley, H. C., 1.

BLACKFORD, FRANCIS W.

1. High-water marks. Assoc. Engin. Soc., Jour., vol. 42, no. 2, pp. 90-92, illus., Feb. 1909.

Describes conditions of erosion and deposition resulting from the flood of October 1906 in the Tuxpan River and the Barranca of Itentique, Mexico. Estimates that 10,000,000 cu. yd. of material were deposited from this particular flood.

BLACKFORD, WILLIAM W.

1. Control of the San Juan River at Greytown [letter to editor]. Sci. Amer., vol. 81, no. 18, p. 278, illus., Oct. 28, 1899.

Discusses the physical problems involved in the construction of the proposed Nicaragua canal with particular reference to the control of the San Juan River at Greytown, Nicaragua. Notes that silt discharged into the sea by the San Juan River finds lodgement, due to coastal currents, in the harbor of Greytown; annual silt discharge is estimated at 600,000 cu. yd. Proposes a new channel for the lower San Juan River with outlet in Greytown Lagoon, the river current forming a junction with outside sea current would carry suspended silt beyond the harbor and distribute it along the coast.

BLACKWELDER, ELIOT.

1. The Gros Ventre slide, on active earth-flow. Geol. Soc. Amer. Bul., vol. 23, pp. 487-492, illus., Oct. 21, 1912.

Describes the Gros Ventre slide south of Yellowstone Park in the valley of Lake Creek, a tributary of the Gros Ventre River. Notes that, in a classification of landslides by Howe, this slide will be placed with the mudflows.

2. Mudflow as a geologic agent in semiarid mountains. Geol. Soc. Amer., Bul., vol. 39, no. 2, pp. 465-484, June 30, 1928; [abstract], Geol. Soc. Amer., Bul., vol. 39, no. 1, p. 206, Mar. 1928.

Considers mudflows in the mountains of semiarid regions which are caused by cloudbursts. Notes that the material of the flow is till-like in character and that boulders weighing hundreds of tons may be carried miles away from the mountain front. States that mudflows are dominant components of the steepest fans of the semiarid mountain ranges.

BLAESS, A. F.

1. (and others). Suitable types of construction for levees, dikes and mattresses for use under varying service conditions, giving consideration to stream alignment, subsurface, soil or other local conditions. Assoc. Chinese and Amer. Engin. Jour., vol. 13, no. 1, pp. 20-31, Jan./Feb. 1932. G. J. Bell, E. A. Craft, A. F. Crowder, H. A. Dixon, B. Elkind, F. G. Jonah, and C. E. Weaver, joint authors.

Presents specifications for the construction of suitable levees, dikes, and mattresses for use in protecting river banks under varying service conditions with consideration given to local stream alignment, subsurface, soil and other conditions. Considers specified hydraulic method of levee construction, specifications for woven willow mattress, pole and brush bank mattress, pole brush and rock dikes, and brush fascines. Describes various forms of protection works in use.

BLAIR, G. W. SCOTT. See Dix, F. J., 1.

BLANCHARD, C. J.

1. The conquest of the Colorado. Conservation, vol. 15, no. 3, pp. 143-147, illus., Mar. 1909.

Discusses details of construction of the Laguna weir on the Colorado River. Notes method of controlling sediment in the reservoir.

BLANCHARD, FRANCIS B.

1. Erosion control in East Bay watersheds. Amer. Water Works Assoc. Jour., vol. 39, no. 12, pp. 1229-1236, Dec. 1947.

Presents the results of sedimentation surveys on Chabot, Upper San Leandro, and San Pablo Reservoirs, and discusses erosion control measures developed to reduce silting. East Bay reservoirs are losing storage due to silting at a rate of 150 acre-feet per year. Sediment sampling has been carried out at 20 sampling stations since 1943 to determine sediment source areas. Up to the present time 105 separate erosion-control structures have been built in the San Pablo watershed, including 20 Missouri-type dams with drop inlets and 20 rubble masonry check dams. Over 400,000 trees have been planted in the past 40 yr. An appraisal of the results of the control program is given.

BLANEY, HARRY F. See Eaton, E. C., 1; Fortier, S., 3; Griffith, W. M., 2; Grunsky, C. E., 5; Lane E. W., 4; Rothery, S. L., 4; Stevens, J. C., 2; Wilm, H. G., 1; Witzig, B. J., 1.

BLANKE, JOHN H. D.

1. Imperial Dam diverts to 72 clarifiers. Internatl. Engin., vol. 74, no. 1, pp. 3-8, illus., July 1938. Describes the construction at Imperial Dam on the Colorado River near Yuma, Ariz., of the largest clarifier installation capable of desilting 12,000 sec.-ft. of water for diversion to the All-American Canal.

BLASINGAME, R. U. See Woodward, S. M., 1.

BLENCH, T.

1. The Lacey slope formula. Punjab Engin. Cong., Minutes of Proc., vol. 23, pp. 123-128, illus., 1935. Demonstrates that the silt factor (f) of a large system of canals is easily obtained by the Lacey Slope Formula.
2. Scientific irrigation channel design. Punjab. Engin. Cong., Minutes of Proc., vol. 24, pp. 1-17, 1936. Explains the meaning and correct application of the principles of design of channels formed in their own silt as given by Lacey in Inst. Civ. Engin. Papers nos. 4736 and 4893.
3. The Lacey theory of uniform flow in alluvial rivers and canals. Indian and East. Engin., vol. 78, no. 5, pp. 381-383, May 1936. Explains from a conventional dimensional viewpoint the Lacey formulae for uniform flow in alluvial channels.
4. A general hydraulic flow formula. Water and Water Engin., vol. 40, no. 494, pp. 292-296, June 1938. Discusses a general hydraulic formula and its derivation, and comments on accepted flow formulae. Gives some results of the author's energy theory, and presents an idea which may be of value in studying the mechanism of silt transport.

BLISS, JOHN H. See Grover, N. C., 12; Stevens, J. C., 6. BLISS, W. J. A.

1. The apparent forces between fine solid particles totally immersed in liquids. Phys. Rev., vol. 2, no. 4, pp. 241-259; no. 5, pp. 373-386, 1895. Describes experiments which were made to reproduce and explain the phenomena of flocculation, and attempts to give a fuller theory of these phenomena.

BLOODGOOD, DEAN W.

1. (and Meador, A. A., and Cook, A. C.). The silt load of Texas streams. 99 pp., illus. Austin, Tex. Bd. Water Engin. and U. S. Soil Conserv. Serv., 1940. A cooperative investigation to obtain facts regarding the amount of silt carried by Texas streams. The length of life of proposed reservoirs may be estimated from these data. This is the first of a series of yearly progress reports. It contains a compilation of sediment data of Texas streams obtained, Feb. 10, 1900-Sept. 30, 1939, from 27 stations on 10 main watersheds in Texas. Technique of making determinations and description of silt-sampling equipment are included. Comments on the weight of silt deposits in reservoirs. Gives a general summary of Texas stations, including measurements made at the Wichita Falls station on the Wichita River; Denison station on

the Red River; Logansport station on the Sabine River; Rockland station on the Neches River; Rosser and Romayor stations on the Trinity River; Humble station on the west fork of the San Jacinto River; Aspermont and Seymour stations on the Salt Fork of the Brazos; Aspermont station on the Double Mountain Fork of the Brazos; Crystal Falls and Eliasville stations on the Clear Fork of the Brazos; Little River station on the Little River; Circleville station on the San Gabriel River; Mineral Wells, Glen Rose, Waco, Bryan, and Rosenberg-Richmond stations on the Brazos River; San Saba, Tow, Austin, and Columbus-Eagle Lake stations on the Colorado River; Falls City station on the San Antonio River; Three Rivers station on the Nueces River; Eagle Pass and Roma stations on the Rio Grande.

2. Progress report of cooperative silt and irrigation investigations in Texas to the State Board of Water Engineers for the biennium ended Aug. 31, 1940. Tex. Bd. Water Engin., Bien. Rpt., (1938-40) 14, pp. 62-74, 1941.

Deals with cooperative silt and irrigation investigations in Texas for the biennium ended Aug. 31, 1940. An account of silt investigations including determinations of silt loads of some of the principal streams of Texas.

3. (and Meador, A. A.). The silt load of Texas streams. II. 23 pp. Austin, Tex. Bd. Water Engin. and U. S. Soil Conserv. Serv., 1941.

A progress report of sediment-load determinations in Texas streams for the water year ending Sept. 30, 1940. Data include measurements made at Logansport station on the Sabine River; Rockland station on the Neches River; Romayor station on the Trinity River; Humble station on the west fork of the San Jacinto River; Richmond station on the Brazos River; San Saba, Austin and Columbus-Eagle Lake stations on the Colorado River; Three Rivers station on the Nueces River; and Eagle Pass and Roma stations on the Rio Grande.

4. (and Meador, A. A.). The silt load of Texas streams. III. 24 pp. Austin, Tex. Bd. Water Engin. and U. S. Soil Conserv. Serv., 1942.

A progress report of sediment-load determinations in Texas streams for the water year ending Sept. 30, 1941. Data include measurements made at Logansport station on the Sabine River; Rockland station on the Neches River; Romayor station on the Trinity River; Humble station on the west fork of the San Jacinto River; Richmond station on the Brazos River; San Saba, Austin, and Columbus-Eagle Lake stations on the Colorado River; Three Rivers station on the Nueces River; and Eagle Pass and Roma stations on the Rio Grande.

5. (and Meador, A. A.). The silt load of Texas streams. IV. 42 pp. Austin, Tex. Bd. Water Engin. and U. S. Soil Conserv. Serv., 1943.

A progress report of sediment-load determinations in Texas streams for the water year ending Sept. 30, 1942. Data include measurements made at Logansport station on the Sabine River; Rockland station on the Neches River; Romayor station on the Trinity River; Humble station on the west fork of the San Jacinto River; South Bend, Possum Kingdom Dam, and Richmond stations on the Brazos River; Easterly station on the Navasota River; Cotulla, Three Rivers, and Corpus Christi stations on the Nueces River; San Saba, Inks Dam, Austin, and Columbus-Eagle Lake stations on the Colorado River; Llano station on the Llano River; Johnson City station on the Pedernales River; Spring Branch station on the Guadalupe River; Goliad station on the San Antonio River; and Crowell station on the Peace River.

6. (and Meador, A. A.). The silt load of Texas streams. V. 49 pp. Austin, Tex. Bd. Water Engin. and U. S. Soil Conserv. Serv., 1944.

A progress report of sediment-load determinations in Texas streams for the water year ending Sept. 30, 1943. Contains a summary of data of all Texas silt stations, both active and discontinued. Describes silt-sampling equipment, method of sampling, and laboratory procedure.

- Comments on the weight of silt deposits in reservoirs. Data compiled include measurements made at the Easterly station on the Navasota River; South Bend, Possum Kingdom Dam, and Richmond station on the Brazos River; Llano station on the Llano River; Johnson City station on the Pedernales River; San Saba, Inks Dam, and Austin stations on the Colorado River; Spring Branch station on the Guadalupe River; Rockland station on the Neches River; Cotulla, Three Rivers, and Corpus Christi Dam stations on the Neches River; Crowell station on the Peace River; Eagle Pass and Roma stations on the Rio Grande; Logansport station on the Sabine River; Goliad station on the San Antonio River; Humble station on the west fork of the San Jacinto River; and Romayor station on the Trinity River.
7. (and Meador, A. A.). The silt load of Texas streams. VI. 49 pp., illus. Austin, Tex. Bd. Water Engin., 1945.
A progress report of a cooperative investigation of the silt load of Texas streams. Consists of a compilation of data for the period Oct. 1, 1943, to Sept. 30, 1944. Describes the apparatus, method, and procedure of silt sampling used. Includes suspended-load data for the following stations: Eagle Pass and Roma on the Rio Grande; South Bend, Possum Kingdom Dam, and Richmond on the Brazos River; San Saba, Inks Dam, and Austin on the Colorado River; Cotulla, Three Rivers, and Corpus Christi on the Neches River; Easterly on the Navasota; Llano on the Llano River; Johnson City on the Pedernales River; Spring Branch on the Guadalupe River; Rockland station on the Neches River; Crowell on the Peace River; Logansport on the Sabine; Goliad on the San Antonio River; Humble on the west fork of the San Jacinto River; and Romayor on the Trinity River. Gives summary of silt records of all silt stations covering the major streams of Texas, both active and discontinued.
 8. (and Meador, A. A. and Cook, A. C.). The silt load of Texas streams. VII. 58 pp., illus. Austin, Tex., Bd. Water Engin., 1946.
A progress report of a cooperative investigation of the silt load of Texas streams. Consists of a compilation of data for the period Oct. 1, 1944 to Sept. 30, 1945. Describes the apparatus, method, and procedure used in silt sampling. Includes suspended-load data for the following stations: Belton on the Leon River; Easterly, South Bend, Possum Kingdom Dam, and Richmond on the Brazos River; Llano on the Llano River; Johnson City on the Pedernales River; San Saba, Inks Dam, and Austin on the Colorado River; Spring Branch and Victoria on the Guadalupe River; Edna on the Lavaca, Horger on the Angelina; Rockland on the Neches; Cotulla, Three Rivers, and Corpus Christi Dam on the Neches River; Crowell on the Peace River; Ruliff and Logansport on the Sabine River; Goliad on the San Antonio River; Huffman on the San Jacinto River; Humble on the west fork of the San Jacinto River; and Romayor on the Trinity River. Gives a summary of silt records of all Texas silt stations on the major streams of Texas, both active and discontinued.
 9. Progress report of cooperative silt, irrigation, and evaporation research studies in Texas during the calendar year 1947. 35 pp., illus. Austin, Tex., Div. Irrig. Res. and Water Conserv., U. S. Soil Conserv. Serv., 1948.
Annual report of silt research and irrigation studies in Texas under a cooperative agreement with the Texas Board of Water Engineers for the fiscal year 1947. Deals with data on the suspended silt load of Texas streams, requirements and application of irrigation waters, determination of a coefficient to apply for evaporation losses from various types of pans and from free water under conditions in Texas. Contains a table which gives a summary of silt-load data obtained from many Texas streams. Gives the characteristics of the suspended silt load of Texas streams.
 10. (and Stout, Ivan M.). The silt load of Texas streams. VIII. 56 pp. Austin, Tex. Bd. Water Engin. and U. S. Soil Conserv. Serv., 1947.
A progress report of sediment-load determinations in Texas streams for the water year ending Sept. 30, 1946. Gives a summary of all Texas silt stations both active and discontinued. Describes sampling equipment, methods of sampling, and laboratory procedure. Deals briefly with the computing of the weight of silt deposits in reservoirs. Data compiled include measurements made at Belton station on the Leon River; Easterly station on the Navasota River; South Bend, Possum Kingdom Dam, and Richmond stations on the Brazos River; Llano station on the Llano River; Johnson City station on the Pedernales River; San Saba, Inks Dam, and Austin stations on the Colorado River; Spring Branch on the Guadalupe River; Victoria station on the Guadalupe River; Edna station on the Lavaca River; Horger station on the Angelina River; Rockland station on the Neches; Cotulla, Three Rivers, and Corpus Christi Dam stations on the Neches River; Crowell station on the Peace River; Ruliff and Logansport stations on the Sabine River; Goliad station on the San Antonio River; Huffman station on the San Jacinto River; Humble station on the west fork of the San Jacinto River; and Romayor station on the Trinity River.
 11. (and Stout, Ivan M.). The silt load of Texas streams. IX. 54 pp. Austin, Tex. Bd. Water Engin. and U. S. Soil Conserv. Serv., 1948.
A progress report of sediment-load determinations in Texas streams for the water year ending Sept. 30, 1947. Gives a summary of all Texas silt stations, active and discontinued. Data compiled include measurements made at the Belton station on the Leon River; Easterly station on the Navasota River; South Bend, Possum Kingdom Dam, and Richmond stations on the Brazos River; Llano station on the Llano River; Johnson City station on the Pedernales River; San Saba, Inks Dam, and Austin stations on the Colorado River; Spring Branch and Victoria stations on the Guadalupe River; Edna station on the Lavaca River; Horger station on the Angelina River; Rockland station on the Neches River; Cotulla, Three Rivers, and Corpus Christi Dam stations on the Neches River; Crowell station on the Peace River; Logansport station on the Sabine River; Goliad station on the San Antonio River; Huffman station on the San Jacinto River; Humble station on the west fork of the San Jacinto River; and the Romayor station on the Trinity River.
 12. Progress report No. 10 of silt load of Texas streams (1947-48). 58 pp., illus. Austin, Tex. Bd. Water Engin. and U. S. Soil Conserv. Serv., 1949.
A progress report of sediment-load determinations in Texas streams for the water year ending Sept. 30, 1948. Gives a summary of all Texas silt stations, active and discontinued. Data compiled include measurements made at the following stations: Belton on the Leon River; Easterly on the Navasota River; South Bend, Possum Kingdom Dam, and Richmond, on the Brazos River; Llano on the Llano River; San Saba, Inks Dam, Buchanan Dam, and Austin, on the Colorado River; Spring Branch and Victoria, on the Guadalupe River; Edna on the Lavaca River; Horger on the Angelina River; Rockland on the Neches River; Cotulla, Three Rivers, and Corpus Christi Dam on the Neches River; Logansport on the Sabine; Goliad on the San Antonio River; Huffman on the San Jacinto River; Humble on the west fork of the San Jacinto River; and Romayor on the Trinity River.

BLUE, F. K.

1. Flow of water carrying sand in suspension. Engin. and Mining Jour., vol. 84, no. 12, pp. 536-539, illus., Sept. 21, 1907.
Describes experiments during March and April 1906 to determine conditions of grade and ve-

- locity under which sand, in a mixture of sand and water, would settle to the bottom of a launder, and to determine the effect of sand in suspension on the coefficient of fluid friction of water running in a launder.
- BLUE, F. L., JR.
1. (and Herbert, J. K., and Lancefield, R. L.). Flow around a river bend investigated. *Civ. Engin.*, vol. 4, no. 5, pp. 258-260, illus., May 1934. Presents results of an investigation on the behavior of the Iowa River in flowing around a sharp bend (mile 88 on Iowa River, near Iowa City, Iowa). Includes note on the downstream movement of the bend.
- BOGARDI, JOHN.
1. (and Yen, C. H.). Traction of pebbles by flowing water. 66 pp. June 1938. Unpublished thesis (M. S.)—State University of Iowa; [abstract], Iowa Univ. Studies in Engin., Bul. 19, pp. 59-60, May 1939. Analyzes traction tests of three gravels ranging in size from 7.1 mm. to 15.5 mm. conducted in flume with two different widths and various bottom slopes, in terms of tractive force, bottom velocity, and mean velocity. The competent bottom and mean velocities were constant and independent of the bottom slope. Some relation to the bottom slope was shown by slope-depth products. The study indicates that the width of the flume affects the influence of the roughness factor, tractive force, and the velocity distribution.
 2. A lebegtetett hordalék toménysége (Suspended silt concentration). *Hidrologiai Közölny*, vol. 27, nos. 9-12, 1947; also in *Hungary Natl. Water Bd., Hydrographic. Sect. Studies 5*, 11 pp., illus., 1948. In Hungarian with English summary. Treats of the method of determining the suspended silt concentration of a stream. Points out that by determining the concentration at a single point of a vertical by measurements, the suspended silt may be computed. By using more verticals the silt load passing over the whole cross section can be obtained. Considers the determination of the amount of suspended silt with the aid of hydraulic characteristics of the river bed. Comments on investigations by Lane, Kalinske, and Hsia. Includes data on suspended load measurements on the Tisza River.
- BOGERT, C. L. See Flinn, A. D., 1.
- BOLLINGER, C. J.
1. A preliminary interpretation of certain peculiarities of the North and South Canadian River basins in the Red Beds area of Oklahoma. *Okla. Acad. Sci., Proc.*, vol. 3, pp. 117-120, 1923. Discusses features of these basins in contrast to the nearby Cimarron and Washita basins. Most striking features of North and South Canadian basins are their narrowness, height above sea level, and the small local relief and unbroken character of topography. Several hypotheses are advanced: that greater elevation is due to arching up of rocks, that underlying rocks are more resistant, and that conditions outside the region have reduced the downward cutting of North and South Canadian Rivers. The writer believes the latter to be the case and continues with a discussion of sedimentation in stream bottoms which prevents downward cutting of streams.
- BOND, W. N.
1. (and Newton, Dorothy A.). Bubbles, drops, and Stokes' law. London, Edinb. and Dublin Phil. Mag. and Jour. Sci., (ser. 7) vol. 5, no. 30, pp. 794-800, illus., Apr. 1928. Demonstrates experimentally and theoretically that the surface tension of a drop or bubble has a decreasing effect on the terminal velocity. Points out that for radii appreciably less than a certain critical value the bubble or drop acts almost like a rigid sphere. The effect of surface tension is small for all radii appreciably larger than the critical, after a rapid transition.
- BONDURANT, D. C. See Stanley, J. W., 5; Stevens, J. C., 6.
- BONNER, FRANK E. See Sonderegger, A. L., 2; Stevens, J. C., 2, 6.
- BONNET, F.
1. Dévasement des réservoirs (Desilting of reservoirs). In his *Cours de Barrages*, pp. 400-406. Librairie de l'Enseignement Technique, 1920. In French. Translation on file at U. S. Soil Conservation Service, Washington, D. C. Discusses the general problem of desilting reservoirs. Comments on methods used in Algeria, such as the system used by Mr. Jandin.
- BONNEY, CANON T. G.
1. Moraines and mud-streams in the Alps. *Geol. Mag.*, (n. s.) Decade 4, vol. 9, no. 1, pp. 8-16, illus., Jan. 1902. Describes debris deposited by flood torrents in the Alps. Notes that the deposits of debris are often moraine-like in character.
- BONSTEEL, JAY A. See Sharpe, C. F. S., 3.
- BORER, O. See also Lacey, G., 6.
1. (and others). The great Ouse catchment board. II. Water and Water Engin., vol. 39, no. 474, pp. 53-64, illus., Feb. 1937. W. Gribbin, D. O'Shea, and W. F. Pattison, joint authors. Describes details of construction of the River Ouse tidal model, surveys and experimental work with the model, correlation of the estuary and the model, silt sampling, and results of mechanical analyses of sands in The Wash and estuary. Gives conclusions relative to proposed model studies.
 2. Recent coastal changes in south-eastern England; changes in The Wash. *Geog. Jour.*, vol. 93, no. 6, pp. 491-496, illus., June 1939. Discusses changes caused by reclamation dating to pre-Roman times. Gives data on area reclaimed for different periods and rate of accretion due to warping.
- BORLAND, WHITNEY M.
1. Sedimentation program of the Bureau of Reclamation. Fed. Inter-Agency Sedimentation Conf., Denver, Proc., 1947, pp. 43-45, 1948. Gives a broad picture of the program and future plans of study and research.
- BORST, H. L.
1. (and Woodburn, Russell). Compilation of rainfall and runoff from the watersheds of the North Appalachian Conservation Experiment Station, Zanesville, Ohio, 1933-38. U. S. Soil Conserv. Serv., SCS-TP-26, 25 pp., illus., tables and graphs, Aug. 1939. Presents hydrologic and land-use data from these watersheds. Ramser silt samplers and silt boxes were used to determine soil loss in runoff.
- BOSE, N. K.
1. (and Ghulati, Thakar Das). Experiments for silt control on a model of the Emerson Barrage, left undersluices, left regulator with a part of the River Chenab upstream. Punjab Irrig. Res. Inst., Res. Pub., vol. 2, no. 25, 11 pp., illus., 1939. Describes and presents results of experiments on a model of the Emerson Barrage, undersluices, and canal regulator to study silt exclusion, movement, and distribution.
 2. (and Malhotra, J. K.). An investigation on the interrelation for silt indices and discharge elements for some regime channels in the Punjab. Punjab Irrig. Res. Inst., Res. Pub., vol. 2, no. 23, 70 pp., illus., 1939. Sets forth results of research on the relation of silt to the hydraulic data of Punjab channels. In connection with the problem of determining the regime of flow of water in artificial channels, silt is considered as a physical and hydraulic entity. A relationship involving some of the usual hydraulic data with a new hydraulic constant defining silt is derived.
- BOSTWICK, L. A.
1. The location, designing and construction of open ditches. *Ind. Engin. Soc., Proc.*, 14, pp. 26-32, 1894. Outlines several requirements for the location, design, and construction of open drainage ditches. Design data for main ditches to re-

BOSTWICK, L. A. - Continued
duce bank erosion to a minimum and to prevent silt deposition and other obstructions are given.

BOSWELL, P. G. H. See also Tester, A. C., 5.

1. The separation of the finer constituents of sedimentary rocks. *Faraday Soc. Trans.*, vol. 18, pt. 1, pp. 34-41, Oct. 1922.
Discusses in connection with soil analysis, separation of the finer constituents of sedimentary rock by elutriation and subsidence, fundamental principals in elutriation based on Stokes' law, and limits of applicability of formula. Describes procedure in elutriation and graphical method of presenting results.
2. The action of colloids in precipitating fine-grained sediments. *Geol. Mag.*, vol. 67, no. 794, pp. 371-381, Aug. 1930.
Treats the determining factors in the rate of subsidence of grains which occur in sedimentary rocks such as gravity, influence of electrolytes, and coprecipitation. Gives data on sedimentation in sea water.
3. On the mineralogy of sedimentary rocks. 393 pp. London, Thomas Murby and Co., 1933.
Discusses history, sources of sediments, correlation, clays, etc. A bibliography and abstracts pertaining to sedimentary petrography are included.

BOTTOMLEY, W. T.

1. A new theory of silt and scour. *Engineering*, vol. 125, pp. 307-308, illus., Mar. 16, 1928.
Discusses R. G. Kennedy's observations as to silt-transporting power of stream as a function of velocity and depth. Notes limitations of Kennedy's formula which does not consider width as a function. Author's theory that uniform gradients in channels, equal to prevailing gradient of country and independent of shape and size of channel, prevent silting of scouring discussed. Justifies use of channel width in determining transporting power of stream. Criticizes W. M. Griffith's use of mean depth instead of hydraulic mean depth. Disproves F. W. Woods' theory on necessary relationship between width and depth in channels. Notes effect of local dredging on silting and scouring, and silting and scouring at bends.

BOUGHTON, V. T.

1. Engineering problems of Nebraska power. *Engin. News-Rec.*, vol. 122, no. 21, pp. 723-726, illus., May 25, 1939.
Considers problems in the development of water power in Nebraska. Silting of bottom is slowly checking seepage in Sutherland reservoir and canal system. Silt content of from .05 to 2.0 percent of Loup River water necessitated construction of skimming weir and other desilting works on Columbus project. Their operation has made silt disposal a routine matter. Seepage was reduced materially in 3 yr. by deposition of fine silt on bottoms of reservoirs and canals.

BOURBEAU, G. A. See Jackson, M. L., 1.

BOUYOUCOS, GEORGE JOHN.

1. The hydrometer as a new method for the mechanical analysis of soils. *Soil Sci.*, vol. 23, no. 5, pp. 343-349, illus., May 1927.
Describes the hydrometer method for the mechanical analysis of soils. Gives experimental data obtained by the use of the hydrometer method. The method presents a means of measuring the rate of settling of soil particles so as to obtain a curve from which to calculate the distribution of soil particles of various sizes.
2. The hydrometer method for studying soils. *Soil Sci.*, vol. 25, no. 5, pp. 365-369, May 1928.
Discusses the hydrometer method of mechanical analysis and presents experimental data bearing upon points of criticism.
3. The hydrometer method for making a very detailed mechanical analysis of soils. *Soil Sci.*, vol. 26, no. 3, pp. 233-238, illus., Sept. 1928.
Points out that with the aid of Stokes' law, the hydrometer method can be used to make a detailed mechanical analysis simply and rapidly. Gives the procedure used.
4. Making mechanical analyses of soils in fifteen minutes. *Soil Sci.*, vol. 25, no. 6, pp. 473-480,

illus., June 1928.

Describes a method of making mechanical analyses of soils in fifteen minutes by the use of the hydrometer method. Gives a table which compares results obtained on 30 different soils by the mechanical analysis and hydrometer methods.

5. A comparison of the hydrometer method and the pipette method for making mechanical analysis of soils, with new directions. *Amer. Soc. Agron. Jour.*, vol. 22, no. 8, pp. 747-751, Aug. 1930.
Notes a comparison between the hydrometer and pipette methods for soil analysis. Believes the hydrometer method can be used with confidence in the mechanical analysis of soils. Describes the features and procedure developed for making mechanical analyses of the soil with the hydrometer method.
6. Studies on the dispersion procedure used in the hydrometer method for making mechanical analysis of soils. *Soil Sci.*, vol. 33, no. 1, pp. 21-26, illus., Jan. 1932.
Reports special tests in dispersion procedure used in the hydrometer method of mechanical analysis. Notes that 10 min. stirring with the mechanical stirrer produced the same amount of dispersion as 16 hr. shaking with the standard shaker.
7. Further studies on the hydrometer method for making mechanical analysis of soils and its present status. *Amer. Soil Survey Assoc., Bul.* 13, pp. 126-131, tables, May 1932.
Consists of a comparative study between the hydrometer and pipette methods of mechanical analysis. Points out that the hydrometer method will do work 30 times faster than the pipette method and give almost as good results.
8. Directions for making mechanical analyses of soils by the hydrometer method. *Soil Sci.*, vol. 42, no. 3, pp. 225-229, Sept. 1936.
Describes the latest procedure and techniques in the use of the hydrometer method to increase the accuracy of making mechanical analyses of soils. The changes or improvements involve a new type of discharging machine, a new type of hydrometer, and a new cylinder unit.
9. A sensitive hydrometer for determining small amounts of clay or colloids in soils. *Soil Sci.*, vol. 44, no. 3, pp. 245-247, illus., Sept. 1937.
Describes a new type of hydrometer developed to measure with a higher degree of accuracy small amounts of clay or colloids in suspension in making mechanical analyses of soils. Heretofore, hydrometers in general use had a total range of 0-60 gm. per l. The new type has a range of 0-10 gm. per l. and is graduated into 0.2 gm. divisions.
10. The high degree of accuracy of the improved soil hydrometer used in the mechanical analysis of soils. *Soil Sci.*, vol. 44, no. 4, pp. 315-317, Oct. 1937.
Discusses procedure and experimental results of tests to determine the accuracy of the new, improved type of soil hydrometer in measuring suspended matter in undisturbed and mixed columns. Comparison of results with the gravimetric method indicates that the hydrometer method is practical and accurate.

BOWDEN, NICHOLLS W.

1. Regulation of the Hiwassee River near Charleston, Tenn. *Prof. Mem.*, vol. 4, no. 14, pp. 205-215, illus., Mar./Apr. 1912.
Describes the location, composition, and condition before and after improvement of the various shoals on the Hiwassee River below Charleston, Tenn.
2. Multiple-purpose reservoir operation. *Civ. Engin.*, vol. 11, no. 5, pp. 292-293, illus., May 1941.
Discusses the value of multiple-purpose water-control projects. Notes that in 1937, two years after storage began behind Boulder Dam, silt load at Yuma, Ariz., had been reduced from 96,000 acre-feet to about 8,500; 80 percent of silt entering stream below Boulder is removed by desilting works at Imperial Dam.

BOWEN, EDWARD.

1. California reservoirs silt up slowly. *Engin. News-Rec.*, vol. 79, no. 4, pp. 169-170, illus., July 26, 1917.

Points out that 50-yr.-old reservoirs on Yuba and Feather Rivers are still in service in 1917. Discusses conditions influencing silting. Existence of glacial lakes in high Sierras indicates absence of silt flowing through them. Sweetwater Reservoir lost 4 percent capacity in 12 yr. due to silting; Lake Chabot, 16 1/2 percent in 36 yr. La Grange Reservoir on the Tuolumne River, studied by J. P. Lippincott of the U. S. Geological Survey, lost 54.2 percent capacity from 1895 to 1905 due to silting. Concludes that silt deposit in reservoirs amounts to only a small percentage of stream flow in California.

BOWIE, AUGUST J.

1. Mining debris in California rivers. *Tech. Soc. Pacific Coast, Trans.*, vol. 3, pp. 1-80, illus., Feb./Mar. 1887.

Deals in detail with the problem of the control of mining debris in streams in California. Estimates of material moved annually and accumulated in the various canyons of streams in the mining region are included. A detailed discussion on the construction of debris barriers is given.

BOWLUS, FRED D. See Sonderegger, A. L., 1; Wilm, H. G., 1.

BOWMAN, ISAIAH.

1. Deflection of the Mississippi. *Science*, vol. 20, no. 504, pp. 273-277, illus., Aug. 26, 1905.

Gives qualitative and quantitative data on the effect of the earth's rotation in deflecting the courses of streams. Compares maps of the Mississippi River from Rosendale, Ark. to Bayou Goula Bend, La. for 1883 and 1896 showing that bank cutting in meanders on right side exceeds corresponding left side cutting by more than 16 percent, due probably to the deflective force of the earth's rotation. Notes necessity of considering other conditions external to the river. Comments on the Rogue River and streams of Long Island with reference to theory of deflection caused by the earth's rotation.

2. Headwaters control and use - influence of vegetation on land-water relationships. *Upstream Engin. Conf. Washington*, Sept. 22-23, 1936, pp. 76-95, illus., Apr. 1937.

Discusses the influence of vegetation as watershed protection. Describes studies on delaying runoff and soil removal by the use of vegetation. Emphasizes the influence of natural vegetation, such as forests and grass, on the regimen of stream flow and erosion.

Discussion: FORREST SHREVE, pp. 95-101, comments on the protection from erosion given by vegetation. Notes that the Gillespie Dam on the Gila River is an example of conversion into a swamp. WALTER C. LOWDER-MILK, pp. 101-104, comments on the hazards of cultivation to sustained use of soil and water resources in relation to successful upstream engineering. CARL O. SAUER, pp. 104-105, notes the slopes that lie above stream courses, effects of vegetation, and use of forage plants to prevent erosion.

BOYER, M. C.

1. Sediment transportation in streams in relation to power-plant operation. *Midwest Power Conf., Proc.*, vol. 10, pp. 175-183, 1948.

Considers sediment transportation in streams in relation to power-plant operations.

2. (editor). Third decade of hydraulics at the State University of Iowa. *Iowa Univ., Studies in Engin.*, Bul. 33, 87 pp., illus., 1949.

A report which describes the Iowa Institute of Hydraulic Research. Reviews Institute research and presents abstracts of graduate theses including 9 which deal with sedimentation (pp. 57-60).

BRADFIELD, E. R.

1. Sluits and their remedy [letter to editor]. *Cape of Good Hope Dept. Agr., Agr. Jour.*, vol. 24, no. 5, p. 627, May 1904.

Notes the extent of soil erosion due to rapidly increasing sluits in the Cape of Good Hope, Africa, and describes means of providing silt barriers by the use of growths of pampas grass.

BRADFIELD, RICHARD. See Steele, J. B., 1.
BRADFORD, WELMAN.

1. Louisiana waters and their industrial possibilities. *La. Engin. Soc., Proc.*, vol. 3, no. 6, pp. 262-272, illus., Dec. 1917.

Describes a proposed method for the application of fertilizing waters to the rice lands of Louisiana by gravity irrigation, and considers the fertilizing value of Red River silt.

BRADLEY, J. A.

1. Reed-backed fences for channel protection. *Civ. Engin.*, vol. 14, no. 9, pp. 387, 388, Sept. 1944.

Describes the use of rail and wire mesh fencing, backed with reeds tied in bundles, for the protection of banks and levees against scour and wash-out during times of heavy storm runoff in small streams in Orange County, Calif. Gives methods of installation, methods of growing of reeds, and costs of channel-protection work.

BRAINE, C. DIAMOND H.

1. The possibilities of irrigation in South Africa.

Cape of Good Hope, Dept. Agr. Agr. Jour., vol. 24, no. 1, pp. 48-58, Jan. 1904.

Deals with various aspects of irrigation possibilities in South Africa. Includes discussion on the value of silt as a fertilizer.

BRAMMALL, ALFRED.

1. Dartmoor detritals: a study in provenance. *Geologists' Assoc., London Proc.*, vol. 29, pt. 1, pp. 27-48, illus., 1928.

Describes the typical detrital assemblage derived from the Dartmoor granites, giving attention to varietal features.

BRANCH, L. V.

1. Aqueduct operating program. *Engin. News-Rec.*, vol. 121, no. 21, pp. 677-679, illus., Nov. 24, 1938.

Describes the program of diverting Colorado River water at Parker Reservoir to terminal storage at Cajalco Reservoir. Prior to closure of Boulder Dam, the average silt load annually transported by the Colorado River past Topock, Ariz., was estimated at 137,000 acre-feet. Silt load entered Parker Reservoir from Bill Williams River at an average annual rate of 1,800 acre-feet. Degradation of the river below Boulder Dam will add a total of 100,000-150,000 acre-feet of silt, with an estimated annual average of 2,880 acre-feet from tributary drainage. These quantities will reduce Parker Reservoir to half capacity in 70-90 yr. After degrading of river bed has ceased, silt from tributaries will cause slow accumulations. Notes use of depression-type sand traps, large sand traps, and means of cleaning traps.

BRANDL, L.

1. Improvements in the Yangtze River delta. *Assoc. Chinese and Amer. Engin., Jour.*, vol. 16, no. 1, pp. 12-15, illus., Jan./Feb. 1935.

Outlines a scheme to stabilize the navigable water conditions at the mouth.

BRANNER, JOHN CASPER.

1. Observations upon the erosion in the hydrographic basin of the Arkansas River above Little Rock. *Ark. Geol. Survey, Ann. Rpt.* (1891), vol. 2, pp. 153-166, 1894.

Presents results of discharge gage and dissolved and suspended load observations on the Arkansas River above Little Rock.

BREAZEALE, J. F.

1. A study of the Colorado River silt. *Ariz. Agr. Expt. Sta. Tech. Bul.* 8, pp. 165-185, illus., Mar. 1, 1926.

Gives results of an extensive study of silt in the Colorado River emphasizing the problem of silt in streams which supply irrigation water. Describes the Colorado River basin, source of silt, and chemical and physical characteristics of Colorado River silt. Discusses silt-carrying capacity of a river as influenced by colloidal dispersion. Notes that silt, as it floats in Colorado River, seems to be dispersed and that the

silt-carrying capacity of a stream may depend on the size of particles in suspension rather than on velocity of current. Silt, as deposited in the lower basin, contains appreciable amounts of replaceable sodium, indicating the presence of dispersed colloids. Variations in quality of Colorado River water are given. Salt content is high during low water and low during spring floods. The effect of various concentrations of hydroxides and salts on dispersion and flocculation of Colorado River silt is given. Quotes Forbes' (1900) estimate that 61,000,000 tons of silt are brought down annually by the Colorado River.

BREEDING, SETH D.

1. Texas floods of 1940. U. S. Geol. Survey, Water-Supply Paper 1046, 91 pp., illus., tables, 1948. Presents records of rainfall and various other data for the June-July storm and the November storm. Comparative records of sediment transported by floods in San Jacinto, Brazos and Colorado Rivers are given.

BREWER, WILLIAM H.

1. On the subsidence of particles in liquids. *Natl. Acad. Sci., Mem.* (1883), vol. 2, pp. 165-175, 1884. Presents results of investigations made from 1875 to 1883 on the subsidence of particles in liquids. Discusses delta phenomena of the Mississippi, and influence of salts and foreign matter on the power of water to hold material in suspension.
2. On the suspension and sedimentation of clays. *Amer. Jour. Sci. (ser. 3)*, vol. 29, no. 169, pp. 1-5, Jan. 1885. Presents results of experiments on the rate of settling of clay in water. Discusses effect of temperature changes of water, additions of saline and acid solutions to water, and effects of flocculation of clay particles upon the rate of settling.

BRIDGEMAN, A. S.

1. Sundays River valley. *So. African Irrig. Dept. Mag.*, vol. 3, no. 1, pp. 24-26, Mar. 1924. States that a 72-hr. discharge of silt through a valve at Lake Mentz is due to the nature of the flood and the condition of the reservoir. Notes the fertilizing value of silt.

BRIGGS, LYMAN J.

1. (and Martin, F. O., and Pearce, J. R.). The centrifugal method of mechanical analysis. *U. S. Bur. Soils, Bul.* 24, 38 pp., illus., 1904. Describes the centrifugal method of soil analysis as used by the Bureau of Soils. Includes an investigation of the various features of the centrifugal method. Describes other methods of mechanical soil analyses such as: Hilgard's Elutriator; Osborne's Beaker Method; King's Aspirator Method; and Yoder's Centrifugal Elutriator Method.

BRITISH EMPIRE FORESTRY CONFERENCE, 4TH. COMMITTEE ON FORESTS IN RELATION TO CLIMATE, WATER CONSERVATION AND EROSION.

1. Report. *So. Africa, Dept. Agr. and Forestry, Bul.* 159, 62 pp., illus., 1935. A report on the subject of forest influences. Includes brief notes on the effects of erosion upon stream and valley siltation.

BRITT, R. H.

1. Bed-load drift across current [letter to editor]. *Engin. News-Rec.*, vol. 111, no. 11, pp. 326-327, Sept. 14, 1933. Comments on New Plans for the Mississippi (Anonymous, 108), which explains the drift of bed-load sand away from the concave side of channel curves as a tendency of bed load to move to zones of lower velocity. Compares this drift with drift of gold in crucibles of gold and silver assayers during process of separating low-grade bead of gold and silver. Advances theory that when water is in whirl a horizontal pressure is developed by centrifugal force increasing from center to periphery. A submerged body is subjected to force, exerted in the direction of horizontal pressure, equal to that of centrifugal force set up by volume of water equal to that of body. When body is in

suspension, its centrifugal force counteracts horizontal pressure of water but when it drags along bottom centrifugal force becomes practically nil and it moves under horizontal water pressure toward the center.

BROMWICH, T. J. I' A.

1. Motion of a sphere in a viscous fluid. *Cambridge Phil. Soc., Proc.*, vol. 25, pt. 4, pp. 369-383, Oct. 1929.

A mathematical treatment of the motion of a sphere in a viscous fluid. Considers the way in which the sphere approaches a steady value. Considers operational methods introduced by Heaviside. Follows lines adopted by Stokes in order to obtain equations of motion so as to apply operational methods for their solution.

BROOKS, BENJAMIN.

1. Erosion of watersheds and its prevention. *Ill. Soc. Engin. Ann. Rpt.*, 31, pp. 64-67, 1916.

Stresses need for adequate soil erosion control and conservation measures on agricultural lands in order to prevent river clogging, flood increases, and harbor shoaling. Notes briefly changes in the channel of the Chemung River, N. Y. 1840-90.

BROOKS, ODIN P. See Tolman, R. C., 2.

BROTHERHOOD, G. R.

1. (and Griffiths, J. C.). Mathematical derivation of the unique frequency curve. *Jour. Sedimentary Petrology*, vol. 17, no. 2, pp. 77-82, illus., Aug. 1947.

Describes a mathematical derivation of the unique frequency curve. Discusses briefly the application of the method and its limitations.

BROUGHTON, W. A.

1. [Review of] Some principles of accelerated stream and valley sedimentation, by Stafford C. Happ, Gordon Rittenhouse, and G. C. Dobson. *Jour. Sedimentary Petrology*, vol. 11, no. 1, pp. 49-50, Apr. 1941.

A summary of studies (Happ, S. C., 6) of stream and valley sedimentation in the drainage basins of Tobittubby and Hurricane Creeks in Lafayette County, Miss. Contains a bibliography on erosional and depositional problems of other regions.

BROWN, ANDREW.

1. (and Dickeson, M. W.). The sediment of the Mississippi River. *Amer. Assoc. Adv. Sci., Proc.*, (1848) vol. 1, pp. 42-55, 1849.

Results of experiments and calculations relative to the quantity of suspended material transported by the Mississippi River and the effects of its deposition on the formation of land or the filling up of depressions are given.

BROWN, CARL B. See also Barnes, F. F., 3, 4; Eakin, H. M., 8, 9; Hathaway, G. A., 1; Lane, E. W., 21; Longwell, C. R., 2; Marshall, R. M., 1; Stevens, J. C., 6; Witzig, B. J., 1; Twenhofel, W. H., 14.

1. Studies of reservoir silting. *Soil Conserv.*, vol. 1, no. 10, pp. 1-5, 14, illus., May 1936.

Deals with studies of reservoir silting by the U. S. Soil Conservation Service, and economic effect of depletion of storage capacity. Notes that loss in capacity of the water-supply reservoir at Elk City, Okla. amounted to 48 percent in 10 yr.; Old Lake Austin, 48 percent in 6.75 yr.; New Lake Austin, 95 percent in 13 yr.; storage reservoir at Waco, Tex., 12.38 percent in 5 yr., or at the rate of 2.48 percent per year; and Zuni Reservoir, N. M., 76.5 percent in 25 yr. Notes protective work on watershed of Los Nutrias, principal silt-producing tributary at Rio Grande, and the sluicing operations at Zuni Dam reduce silt deposits in Zuni Reservoir. Survey in 1935 shows loss to Elephant Butte of 13.8 percent of its capacity, at the rate of 0.68 percent per year. Describes economic effect of silting in all small reservoirs and many of major size in Piedmont region. Discusses causes of reservoir silting noting its relationship to watershed erosion. Notes work of U. S. Soil Conservation Service on detailed surveys of 30 representative reservoirs and on reconnaissance examination of 250 others, range of surveys, reasons for study, future reservoir planning, measurements of watershed erosion, and studies of processes and charac-

- teristics of reservoir sedimentation in order to develop silt control methods supplementary to erosion control practices.
2. (and Barnes, Farrell F.). Advance report on the sedimentation investigations of reservoirs and navigation improvements on the New River, Virginia and West Virginia. U. S. Soil Conserv. Serv., SCS-SS-6, 24 pp., illus., Aug. 1936.
A report on field investigations made during April and May 1936 by the U. S. Soil Conservation Service to determine the effects of accelerated soil erosion on reservoirs and navigation improvements on the New River between its headwaters and Hinton, W. Va. Survey included investigation of storage depletion in Washington Mills Reservoir at Fries, Va., Byllesby Reservoir, 6 miles southeast of Ivanhoe, Va., Buck Reservoir, 3 miles southeast of Ivanhoe, Va., and Fields Manufacturing Co. Reservoir, 4 miles northeast of Mouth of Wilson, Va. The original storage capacity of Fields Reservoir was reduced from 183.81 acre-feet to 109.22 acre-feet in 5.67 yr., an amount equal to 7.16 percent of the original capacity. The original capacity of Washington Mills Reservoir, when completed in 1902, was 2,954 acre-feet. By 1922 this had been reduced to 590.28 acre-feet and by 1936 to 511.47 acre-feet by sedimentation. An attempt to desilt this reservoir by opening gates in the dam and permitting stored water to flow out rapidly, resulted in removal of only 6.76 acre-feet of sediment, thereby increasing the capacity an amount equal to only 0.23 percent of the original storage capacity. The original capacity of Byllesby Reservoir was reduced from 8,892.16 acre-feet to 3,538.35 acre-feet in 23.66-yr. period from August 1912 to date of survey. This amounts to an annual rate of 2.54 percent of the original capacity and a total depletion to date of survey of 60.21 percent. The storage capacity of Buck Reservoir has been depleted at an annual rate of 0.98 percent of the original capacity, at the time of survey, losing a total of 23.16 percent of the original capacity. Approximately 75 percent of the watershed of the reservoirs is either pasture or cultivated land and sheet erosion has been moderate or severe on all land not protected by woodland cover. Results of the survey of navigation channels indicate that there is no deposition of sediment since the current is sufficiently strong to keep them scoured out. However, some sediment is accumulating locally along the course of the river where the gradients are not steep, as in the case of the artificially excavated navigation channels.
 3. (and Barnes, F. F.). Reservoir silting in the New River watershed. Soil Conserv., vol. 2, no. 5, pp. 95, 106-107, illus., Nov. 1936.
Pertains to an investigation made by the Section of Hydrodynamic Studies, Division of Research, U. S. Soil Conservation Service, of erosion conditions in the New River watershed, by means of silt measurements in reservoirs. Offers results of a study on the effect one or more reservoirs have on the silting rate of others downstream. Outlines watershed conditions and gives description and location of Fields Dam, Washington Mills, Byllesby, and Buck reservoirs. Notes character of sediment in reservoirs. Summarizes results of investigations noting 40.58 percent loss of original capacity by silting of Fields Reservoir in 6 yr., 80.02 percent filling of Washington Mills Reservoir over a 20-yr. period and 82.69 percent in 33 yr., and the 60.21 percent and 23.16 percent capacity loss of Byllesby and Buck Reservoirs, respectively in 24 yr. Comments on harm rendered plant operation as a result of greatly reduced storage capacity, noting necessity for flushing silt from Washington Mills Reservoir to maintain uniform power output. Investigations reveal that the silting rate on downstream reservoirs is not necessarily affected by reservoirs upstream. Discusses the significance of rate of silt accumulation in relation to drainage area.
 4. From farm fields to city streets. Soil Conserv., vol. 2, no. 9, pp. 189-190, 198, illus., Mar. 1937.
Discusses effects of the Ohio Valley flood of 1937. Describes conditions in cities where deposits of mud were found and conditions in Miami Valley conducive to the removal of soil and formation of gullies. Describes work of Section of Sedimentation Studies, Division of Research, U. S. Soil Conservation Service, in making measurements and collecting samples of sediment in cities and bottom lands. Includes table giving estimated amount of sediment deposited in Wheeling, and Huntington, W. Va., and in Marietta, Portsmouth and Cincinnati, Ohio. Notes economic losses involved.
 5. Rates of silting in representative reservoirs throughout the United States. Amer. Geophys. Union, Trans., vol. 18, pt. 2, pp. 554-557, July 1937.
Pertains to reservoir silting conditions in representative regions of the United States. Discusses the economic significance of reservoir silting, noting that it is due, in part, to accelerated soil erosion. Points out purpose of studies now under way. Resulting data valuable to reservoir planning, to design of silt prevention works, and to a wide range of hydrologic studies. Describes channel reservoirs of Piedmont section noting that 13 representative reservoirs of that type (used mainly for power purposes) were found to be completely silted at an average age of 29 1/2 yr.; notes damage to power plant parts as the result of passing heavy sediment loads; Fields Reservoir lost 41 percent of its capacity in 6 yr.; Washington Mills Reservoir, 83 percent in 33 1/2 yr.; Byllesby Reservoir, 60 percent in 23 yr.; and Buck Reservoir, 23 percent in 23 yr. Smaller basin-type reservoirs in the same section are silting at a composite average rate of 0.79 percent a year; rates of silting vary from 0.1 percent a year in Lake Purdy near Birmingham, Ala. to 2.1 percent a year in Spartanburg Municipal Reservoir, S. C. In 3 large storage reservoirs at High Rock near Salisbury, N. C., Lloyd Shoals near Jackson, Ga., and Lay Reservoir at Sylacuga, Ala., a uniformity of loss in capacity due to silting is noted, rates of silting being 0.62, 0.51, and 0.52 percent a year, respectively. Survey of Lake Waco, Tex. in 1936 showed average annual depletion in storage capacity of 3.34 percent; the basin-type municipal reservoir at Rogers, Tex. lost 23 percent of its capacity in 12 yr.; White Rock at Dallas, Tex. lost 21 percent in 25 yr. Lake Gibbons and Lake Crook near Paris, Tex. showed rates of silting of 0.15 percent and 0.49 percent, respectively, per annum. Notes possible relationship between rate of silting with storage per square mile of drainage area and land use. Lake Taneycomo on White River, Mo., lost 48.08 percent of its capacity in 22.4 yr., an average loss of 2.06 percent per year; Lake Decatur on Sangamon River, Ill., lost 14.23 percent in 14.2 yr.; Lake Bracken at Galesburg filled nearly 8 percent in 13 yr.; West Frankfort Reservoir, 8 percent in 10 yr.; Lake Calhoun, 52 percent in 12 yr. Results of several silting surveys of Elephant Butte Reservoir show average annual loss of 0.68 percent; average silt content of inflow is 1.65 percent by volume. San Carlos Reservoir on Gila River silted at average rate of 0.47 percent a year, 1928-35; Black Canyon Reservoir on Payette River, Idaho, silted at average rate of 0.89 percent per year for the 12 yr. since completion. Notes results of surveys in California indicating low rates of silting; effects of fire and timber cutting on rate of silting. Gibraltar Reservoir in Santa Barbara County shows a critical rate of silting of 1.84 percent per year. Results of silt surveys show that under present rates of silting the life span of 38 percent of all reservoirs in the United States will be 1-50 yr., 24 percent a life of 50-100 yr., 21 percent a life of 100-200 yr., and only 17 percent a life of more than 200 yr.
 6. Protecting bottomlands from erosional debris; a case history. Soil Conserv., vol. 3, no. 4, pp. 93-

96, illus., Oct. 1937.

Relates to the treatment of the watershed of Chase Creek, Doniphan County, Kans., whose bottomlands are menaced by deposits of erosional debris. Notes damage caused by flooding of crops and debris deposits from the storm of 1917. Describes construction in 1920 of a debris basin east of the mouth of Chase Creek, its complete filling by 1930, and the agricultural value of the sediment deposited therein.

Presents a description of a new basin and a discussion of the economic aspects of debris basin treatment as compared with soil conservation treatment of tributary watersheds.

7. Sedimentation studies by the Soil Conservation Service. Natl. Res. Council, Div. Geol. and Geog., Com. on Sedimentation, Rpt. 1936-37, pp. 10-22, Oct. 1937.

Presents a summary of work completed by the Section of Sedimentation Studies, U. S. Soil Conservation Service Research Division, during the fiscal year 1936-37 and outlines present studies and experiments. Results of sedimentation surveys in various reservoirs throughout the United States and economic aspects of the reservoir silting problem are given. Notes that 13 representative reservoirs of channel type, in the Southern Piedmont region, silted completely at an average age of 29.5 yr.; on the New River in southwestern Virginia, the Fields Reservoir silted 41 percent in 6 yr., Washington Mills 80 percent in 19.5 yr. and 83 percent in 33.5 yr., Byllesby 60 percent in 23 yr. and Buck Reservoir 23 percent in 23 yr. Nine basin-type reservoirs in the piedmont region of North and South Carolina and Alabama showed an average total depletion in capacity of 7.72 percent in an average of 11.67 yr. Describes character and distribution of sediment in Southern reservoirs. In Texas, Lake Waco silted 19.78 percent of its capacity in 6 yr., Rogers Municipal Reservoir 23 percent in 12 yr., White Rock 21 percent in 25 yr., Lake Gibbonsand, 5.52 percent in 36 yr., and Lake Crook 6.37 percent in 13.1 yr. Elephant Butte on the Rio Grande showed total depletion in capacity of 13.48 percent in 20.25 yr., San Carlos Reservoir on the Gila River showed annual average rate of silting of 0.47 percent; distribution of silt in San Carlos was due to silt-laden underflow currents. Notes progress of laboratory studies on compaction, volume-weight relationship, and mechanical and chemical analysis of deposited silt. Summarizes methods of investigation employed in stream and valley silting studies in the Tallahatchie, Miss., middle Rio Grande, N. Mex., and Tiger River, S. C., basins. Describes engineering studies on the Rocky River, N. C., Enoree River, N. C., and South Sandy Creek, Ala., to provide exact sediment measurements for correlation with watershed conditions and to yield data on the relationship between loads of sediment and other hydraulic functions of streams. Notes progress on hydraulic laboratory studies in cooperation with the California Institute of Technology, on the mechanics of sediment transportation by flowing water, effect of transportation on size reduction of sediments, stratified flow in reservoirs and engineering works relative to control of sedimentation.

8. Sedimentation studies by the Soil Conservation Service, 1937-38. Natl. Res. Council, Div. Geol. and Geog., Com. on Sedimentation, Rpt. 1937-38, pp. 106-114, Sept. 1938.

Summarizes principal accomplishments on sedimentation studies by the Division of Research, U. S. Soil Conservation Service during the fiscal year 1937-38. Notes completion of reconnaissance examinations of conditions of accelerated sedimentation made in 35 major watersheds; silting surveys on storage reservoirs located near Washington, D. C.; sedimentation studies in the Southeastern and South Central States and in California after the flood of Mar. 2, 1938 in the Los Angeles area; surveys of silt accumulation and damage on flood

plain and fan areas in 5 southern California Counties; range surveys for future silt investigations on 4 flood-control reservoirs in the Muskingum Valley, Ohio; and survey of sediment sources on watershed above High Point Reservoir, N. C. Progress was made on report relative to the principles of stream and valley silting in connection with accelerated erosion, based on results of studies in the Tallahatchie drainage basins; on studies of stream and valley sedimentation in the Middle Rio Grande Valley, N. Mex.; on silt investigations in Anacostia River, D. C.; on bed-load investigations in Rocky River near Statesville, N. C., South Sandy Creek near Dadeville, Ala., and Enoree River near Greenville, S. C.; on hydraulic laboratory studies in cooperation with the California Institute of Technology on mechanics of suspended load transport, effects of sediment characteristics on suspended load, density currents in reservoirs, technique and interpretation of mechanical analysis, localized stream scour, erosion control models, design of sediment separator, development of suitable instrument to measure high velocity sediment-laden flows, and flume studies on abrasion of sediments.

9. (and Seavy, Louis M., and Rittenhouse, Gordon). Advance report on an investigation of silting in the York River, Virginia. U. S. Soil Conserv. Serv. SCS-SS-32, 12 pp., illus., Mar. 1939.

Report on sedimentation in the York River estuary between West Point and Gloucester Point, Va. Water depths in 1938 compared with those of 1857, 1911, and 1918 on earlier charts. Results of investigation show that from 1857 to 1911 the net accumulation of sediment amounted to 5,591 acre-feet, or 104 acre-feet per year, while from 1911 to 1938 it amounted to 15,293 acre-feet or 566 acre-feet per year, or more than 5 times the rate for the period 1857 to 1911. Comparison of data indicates that a downstream migration of the locus of most active sediment deposit has taken place. Sediment is described. Pertinent data on sedimentation and dredging, as presented in the annual reports of the Chief of Engineers, U. S. Army, are summarized.

10. Annotated bibliography of sedimentation studies by the Soil Conservation Service, 1938-1939. Natl. Res. Council, Com. Sedimentation, Rpt. 1938-39, Exhibit A, pp. 11-18, Sept. 1939.

This bibliography contains 24 annotations of publications by members of the U. S. Soil Conservation Service.

11. Sedimentation studies by the Soil Conservation Service, 1939-1940. Natl. Res. Council, Div. Geol. and Geog., Com. on Sedimentation, Rpt. 1939-40, pp. 89-96, Dec. 1940.

Reviews work of the Sedimentation Division of the U. S. Conservation Service, 1939-40. Points out the practical importance of sedimentation studies as related to national policies and plans of flood control and conservation. Discusses the methods of predicting the rate of silting of new and proposed reservoirs. The problems of stream and valley sedimentation met with in connection with flood control surveys are noted. Describes briefly results of the field and laboratory work of the U. S. Soil Conservation Service during the period.

12. Dynamics of entrainment of erosional debris and sedimentation. Amer. Geophys. Union, Trans., vol. 22, pt. 2, pp. 305-311, illus., 1941.

Discusses results of recent investigations in the United States which illustrate the relation of sedimentation to the dynamics of erosion. Analysis of data from sedimentation studies in reservoirs that trap a major part of the sediment transported to them have indicated that maladjustment of reservoir size to the physical conditions of the watershed is the principal cause of excessive loss of storage. Compares reservoir size and watershed characteristics to rates of silting in the Sardis Reservoir on the Little Tallahatchie River, Miss., and in the Osborne Reservoir on the Salmon River at Osborne, Kans. Results of valley-sedimentation studies have disclosed the principle that

deposition on flood plains of fine sediment coming chiefly from sheet erosion may cause an increase in the area of inundation and resulting flood damage without increase in flood discharge; considers the situation at Elba, Minn., on the Whitewater River. States that if the basic relationship of bed load, suspended load, and discharge on the Enoree River near Greenville, S. C. is confirmed on most other streams, the effects of various conservation practices for reducing the component parts of the sediment load of a stream which are responsible for particular types of damage may be determined. The results and implications of studies of silt-laden density currents in reservoirs and of turbulence and its effects on the transportation of sediment in suspension are briefly noted. Considers the quantitative determination of sources of the damaging components of sediment load and the establishment of protective measures on watersheds in due proportion to these sources of damaging sediment as necessary for the achievement of satisfactory control of sediment production. Data are given on results of studies of rainfall-runoff relations in East and West Tarkio Creeks in Iowa and Missouri, and comparison of surface runoff, silt loss, direct runoff and suspended matter, Tarkio area and La Cross, Wis. area, to illustrate the differences in amounts of stream load and of erosion losses from the land surface.

Discussion: LORENZ G. STRAUB, pp. 311-313, presents several pertinent remarks regarding observations made by the writer in connection with the sedimentary characteristics of midwestern streams forming, particularly, the Missouri River System. Data are given on rates of erosion from various sections of the Missouri River Drainage Basin, July 1, 1929-June 30, 1931, based upon suspended-sediment discharge observations, to indicate the great variation in sediment actually carried by the Missouri River. Questions the validity of Brown's statement that additional sedimentary material is being washed into large rivers in recent years because of agricultural development. Notes that a comparison of suspended-load discharge observations by the writer (1929-31) and by Seddon (1879) on the Missouri River at St. Charles, Mo., indicate that no great change has occurred in the suspended-load discharge of the stream. A table is presented showing the relation of suspended load to bed load of several midwestern rivers which are tributary to the Missouri River and notes that this relation must frequently be considered in planning reservoirs. V. A. VANONI, pp. 313-315, brings out further results of laboratory experiments outlined by Brown dealing with studies on the mechanics of sediment-transportation and in this connection any effects that the sediment may have on flow-characteristics. Some of the important implications of these experimental results are briefly outlined.

13. Effect of silting on storage reservoirs and preventive measures. Pa. Water Works Operators' Assoc., Jour., vol. 13, pp. 68-83, illus., 1941. Describes the silting of storage reservoirs and preventive measures to control silting. Reservoir silting in the State of Pennsylvania is discussed. Data on reservoir silting in Pennsylvania and Maryland are given.
14. Protecting reservoir watersheds through the districts program. Soil Conserv., vol. 6, no. 8-9, pp. 230-323, illus., Feb./Mar. 1941. Summarizes results of reservoir surveys by the U. S. Soil Conservation Service which indicate the magnitude of the reservoir silting problem in the United States. Points out some outstanding factors to be considered by the various Soil Conservation districts in formulating their policies of adequate watershed protection and erosion control.
15. Factors in control of reservoir silting. Amer. Water Works Assoc. Jour., vol. 33, no. 6, pp. 1022-1040, illus., June 1941; also, with title Reservoir silting and factors of importance in silting control, in Water Works and Sewerage, vol. 88, no. 6, pp. 257-263, illus., June 1941.

Describes work of the Sedimentation Division, U. S. Soil Conservation Service, on the problem of silting in public water-supply reservoirs of the United States, including nature, extent, and results of surveys. Analyzes the significance of the silting problem in terms of the average life of all water-supply reservoirs in the country. Considers methods of silting control; costs and effectiveness of pump dredging, sluicing through dam, or dragline excavation; feasible approaches to silting control by adequate consideration of the silt factor in location and design of dams, by improved practice of water release at dams (utilization of underflow phenomenon to vent largest possible amount of sediment before it is deposited and compacted), and by adequate watershed protection to control soil erosion.

16. Reservoir silting and factors of importance in silting control. Water Works and Sewerage, vol. 88, no. 6, pp. 257-263, illus., June 1941. Considers the recency of serious studies of reservoir silting and reports on the work of the U. S. Soil Conservation Service. Calls attention to two different types of reservoir surveys. Comments on reservoir-silting control and recommends conservation practices for erosion control. Density currents are also considered.
17. Mapping Lake Mead. Geog. Rev., vol. 31, no. 3, pp. 385-405, illus., July 1941. Describes methods employed in the mapping of Lake Mead. The survey was undertaken to establish an adequate basis for future measurements of storage capacity losses anticipated from the heavy load of sediment carried into the reservoir by the Colorado River.
18. Silt takes heavy storage toll. Water Works Engin., vol. 94, no. 15, pp. 874-877, 908-909, illus., July 16, 1941. Summarizes known facts concerning rates of silting in water-supply reservoirs. Notes that the U. S. Soil Conservation Service made detailed and reconnaissance surveys on approximately 375 reservoirs, and other agencies made surveys on 75 reservoirs; of the 450 reservoirs, 151 are used for water supply. Data show that of the 151 water-supply reservoirs, 21 percent will have a useful life of less than 50 yr., 25 percent will last 50-100 yr., and only 54 percent will have a useful life 100 yr. hence at the present rate of requirements.
19. Sedimentation studies by the Soil Conservation Service, 1940-1941. Natl. Res. Council, Div. Geol. and Geog., Com. Sedimentation, Rpt. (1940-41) Exhibit D, pp. 26-34, Mar. 1942. Considers reservoir investigations, stream and valley investigations, sediment transportation, and work of the hydraulic laboratory. Lists 17 articles reporting work done by the Sedimentation Division during 1940-41.
20. Report on the sedimentation surveys of Little Rock Reservoir, Los Angeles County, California. U. S. Soil Conserv. Serv., Spec. Rpt. 6, 11 pp., illus., Dec. 1943. Surveys were made by the U. S. Soil Conservation Service in January 1936, June 1938, and October 1943. From the date of its completion in April 1924 to the storm of Feb. 27-Mar. 3, 1938, the reservoir lost less than 2 percent of its original capacity of 4,217 acre-feet. This one storm brought into the reservoir approximately 480 acre-feet of sediment, causing a loss of 11.38 percent of its capacity. Between June 1938 and October 1943 an additional 244 acre-feet of sediment had been deposited in the reservoir, causing a total capacity loss to date of 19.28 percent. A large debris supply, extremely vulnerable to flood scouring, still exists and threatens additional capacity loss.
21. The control of reservoir silting. U. S. Dept. Agr. Misc. Pub. 521, 166 pp., illus., 1943; slightly rev. Aug. 1944; [abstract], Amer. Water Works Assoc. Jour., vol. 36, no. 1, pp. 108-109, Jan. 1944. Describes all of the known methods of reservoir silting control with frequent literature citations. Outlines the history, extent, and value of reservoir developments in the United States. Presents the extent of investigations of

- silting and the effect of silting on various different types of reservoirs, and indicates the magnitude of silting damage in the United States. Describes methods of sedimentation control under 6 major headings: (1) Selection of the reservoir site; (2) design of the reservoir; (3) control of sediment inflow; (4) control of sediment deposition; (5) removal of sediment deposits; and (6) water erosion control. Discusses sources of sediment, effect of land use on methods of erosion control, and planning for watershed control.
22. Downstream interests. *Soil Conserv.*, vol. 10, no. 5, pp. 123-127, illus., Dec. 1944.
Notes that such downstream interests as valley agriculture, drainage, irrigation, flood control, commerce, fisheries, recreation, public health, power, and water supply are all affected by the products of erosion-increased floods and sediment. Discusses the type of damage suffered by each interest. Gives steps necessary to secure the direct participation of each of the 10 major groups of downstream interests in the soil- and water-conservation program.
23. Rates of sediment production in southwestern United States. *U. S. Soil Conserv. Serv. SCS-TP-58*, 40 pp., illus., Jan. 1945.
Attempts to compile, evaluate, and translate into comparable units all data that might be of use in estimating the sediment load of the streams in the region embracing the Great Basin interior drainage, the Gila and Colorado watersheds, and the Pecos and Rio Grande watersheds above the junction of these two rivers. Estimates are made of the probable long-term average annual sediment production from these data and other factors which affect the sediment load of streams.
24. Sediment complicates flood control. *Civ. Engin.*, vol. 15, no. 2, pp. 83-86, illus., Feb. 1945.
Describes the various types of sediment damages associated with floods and gives the extent and monetary costs of these damages in the United States.
25. Protecting municipal watersheds in southeastern States. *Pub. Works*, vol. 76, no. 5, pp. 30-34, illus., May 1945.
Points out that land purchase and reforestation, with proper management and fire control, offer the highest degree of water supply and sanitary protection, and the lowest cost of water treatment. Notes that cities which cannot purchase their entire watershed can aid farmers in conservation plan. Points out that scarcely any form of public works is more flexible or better suited to use idle equipment or labor forces than programs for protecting watersheds.
26. Erosion is menace to water supply. *South. City*, vol. 9, no. 9, pp. 6-8, 25-26, illus., Sept. 1945.
Describes effects of sedimentation upon the water supply of nine southeastern States. Notes the effectiveness of soil conservation measures. Protection measures such as purchase and reforestation of watershed lands, and an erosion-control and soil-conservation program are recommended.
27. Floods and fishing. *Land*, vol. 4, no. 1, pp. 78-79, Winter 1945.
Deals with the effects of floods upon the recreational use of streams for fishing. Assumes that the average of all types of floods would reduce recreation 80 percent. Describes analysis of losses developed in the Meramec River Watershed, Mo. Notes that expenditure of funds to reduce flood flows and silt loads would be justified.
28. Aspects of protecting storage reservoirs by soil conservation. *Jour. Soil and Water Conserv.*, vol. 1, no. 1, pp. 15-20, 43-45, illus., July 1946.
Attempts to clarify the misunderstanding about reservoir silting and how it can be controlled, with particular reference to what soil conservation practices on reservoir watersheds can do and cannot do and to what extent they are economically justified in the solution of this problem. Groups the practical aspects of the subject under five headings: (1) The rate, character, and sources of sediment production from the watershed; (2) the effect of the so-called capacity-watershed (C/W) ratio on the rate of silting; (3) the relative value of dam sites as determined by their abundance and demand for the services which their utilization can produce; (4) the economic pressure of the discount rate in computing benefits from sedimentation control; and (5) the time required for application of soil conservation practices, the costs involved and results to be expected from watershed treatment.
29. Erosion control on watershed lands. *Amer. Water Works Assoc., Jour.*, vol. 38, no. 10, pp. 1127-1137, illus., Oct. 1946.
Discusses conditions of watersheds in regard to problems of reservoir silting, cost of filtration and stability of stream flow. Notes methods of protection of small and larger watersheds, spread of soil-conservation work, and work still needed to be done. Outlines practical steps to be taken to obtain adequate controls on watersheds largely in private ownership.
30. (and Stall, J. B., and De Turk, E. E.). The causes and effects of sedimentation in Lake Decatur. *Ill. Water Survey, Bul.* 37, 62 pp., illus., 1947.
Reports the results of a second sedimentation survey of Lake Decatur made in May-June, 1946; the first survey being made in 1936. Treats additional investigations designed to cover all the important relationships between reservoir capacity, effect of sediment on treatment problems, water needs, water supply from the Sangamon River, and the effects of land use and agricultural practices in the drainage basin. Investigations show, for the first time in this section of the country, the intimate relationship between public water supply and problems of the land; they give a measure of the effects of land use and treatment on the quality of water and the maintenance of storage reservoirs. The results indicate the general nature of the problem confronting other cities which will develop surface supplies as ground-water supplies become developed more fully or become overdeveloped.
31. (and Thorp, E. M.). Reservoir sedimentation in the Sacramento-San Joaquin drainage basins, California. *U. S. Soil Conserv. Serv., Spec. Rpt.* 10, 69 pp., illus., July 1947.
Presents the results of an investigation made to determine the effects of sedimentation on the useful life and on the plan of operation of the flood-control and multiple-purpose reservoirs proposed by the District Engineer, U. S. Corps of Engineers, in the comprehensive flood-control survey report on the Sacramento-San Joaquin basin streams in California, dated Feb. 1, 1945. Bases the estimates of effects of sedimentation in 24 existing reservoirs, 20 of which were surveyed during the present study, on the determination of the trap efficiency of 3 existing reservoirs and of the special weight of deposited sediment in 12 existing reservoirs; and on reconnaissance conservation surveys on approximately 13,000 sq. miles of drainage area. Considers factors which may influence future rates of sedimentation in the proposed reservoirs. Concludes that the proposed reservoirs will retain at least 50 percent of their capacity from a minimum of 200 yr. to a maximum of 8,700 yr. and that the rates of sedimentation will be so low they need not be considered a determining factor in the total capacity to be provided for in determining the plan of operation for the first 50 yr. of life. Points out that sedimentation should be taken into account in designing the outlet works.
32. How effective are soil conservation measures in sedimentation control? *Fed. Inter-Agency Sedimentation Conf., Denver, 1947, Proc.*, pp. 259-266, illus., 1948.
Discusses the nature of the sedimentation problem. Lists seven principal sources of sediment production. Soil conservation measures for erosion control are described, and effectiveness of these measures is noted. Problems of soil erosion west of the 100th meridian are compared to those east of the 100th meridian.

The paper deals mainly with erosion control measures applied to the eastern United States.

Discussion: H. V. PETERSON, pp. 266-270, points out features related to the West's erosion problem. Details are given showing results of erosion control measures on two selected tracts in Arizona. EVAN L. FLORY, pp. 270-273, comments on the application of erosion control measures on the Navajo Reservation. Notes the work done by the C. C. C. program in this area. Discusses briefly multiple-purpose detention—retention dams, diversion dams, and spreading areas constructed in this region.

33. Perspective on sedimentation—purpose of conference. Fed. Inter-Agency Sedimentation Conf., Denver, 1947, Proc., pp. 3-7, illus., 1948.

Reviews the history of sediment-load sampling, and discusses the problem of sediment and the various governmental agencies engaged in this work. Itemizes sedimentation damages to land resources, storage reservoirs, irrigation, etc.

34. A symposium—watershed management in relationship to water runoff and siltation—damages resulting from uncontrolled runoff and sedimentation. Jour. Soil and Water Conserv., vol. 3, no. 1, pp. 21-23, 47, Jan. 1948.

Considers floodwater and sedimentation damages resulting from deforestation, overgrazing, and bad cropping practices. Notes flood damages on agricultural lands, and comments on sedimentation damages to reservoirs, drainage enterprises, irrigation, and navigation. Gives cost of dredging at Baltimore, Md., Harbor.

35. (and Jones, Victor H.). Report on sedimentation in Lake Corpus Christi and the water supply of Corpus Christi, Texas. U. S. Soil Conserv. Serv. SCS-TP-74, 54 pp., illus., Dec. 1938.

Objectives of the investigation were to determine the original and remaining storage capacities of Lake Corpus Christi, and the annual average capacity loss due to sedimentation. The preparation of an accurate map of the lake, and the determination of the date when an insufficient water supply due to a deficiency of prolonged stream flow would be realized for the area. Indicates additional studies and remedial measures. Gives the methods and results in making the sedimentation survey. Notes that the chief cause of capacity loss in the lake is due to the large size of the drainage area as compared to the capacity of the reservoir. Includes a table giving summary of sedimentation data on Lake Corpus Christi and sediment-concentration data for the Nueces River at Three Rivers.

36. Watershed control. Amer. Water Works Assoc. Jour., vol. 41, no. 10, pp. 916-927, illus., Oct. 1949.

Presents the concept of a complete watershed treatment program for the protection of reservoirs in agricultural areas in Midwestern States. Treats the seriousness of the reservoir sedimentation problem. The capacity-watershed ratio is considered and Lake Decatur and Lake Springfield are compared. Gives a chart of relative erosion rates under different vegetal cover. The concept of land use capability is dealt with. Treats results of sedimentation studies on Lake Decatur and Lake Waco which show measurable effects of land use and cropping practices on rates of sedimentation. Considers upstream engineering practices. Notes the flood control activity of the Department of Agriculture.

37. Sediment transportation. 71 pp., illus. Prepared for Engineering hydraulics, to be published by John Wiley & Sons, New York, 1950.

A report which presents the various aspects of sediment transportation. Considers such subjects as sources of sediment, rates of sediment production, methods of production control, properties of sediments, fall velocity, fundamental principles of movement, mechanism of entrainment, movement of bed load, movement of suspended load, design of canals and desilting works, stabilization and improvement of rivers, reservoir sedimentation and

collection and analysis of field data. Includes a table which gives representative records of rates of sediment production and reservoir sedimentation for various streams and reservoirs in the United States.

BROWN, EARL I. See Hall, W. M., 1.

BROWN, FRED R. See Howard, G. W., 1.

BROWN, G. A. M.

1. Note by Mr. G. A. M. Brown, President, Central Board of Irrigation on Mr. Reid's paper "Lacey & Kennedy." India. Cent. Bd. Irrig., Pub. 31, pp. 64-66, 1944.

Discusses the report entitled Lacey & Kennedy (Reid, J. S., 1). Facilitates discussion of Mr. Reid's paper by an appendix incorporating the relationships derived from Manning's formula and $V_0=1.08CD^{1/2}$. Shows that an optimum V/V_0 can be obtained mathematically by using the V_0 equation and Manning's.

BROWN, HUGH A. See Johnson, J. W. 5.

BROWN, J. B. See Fairbank, J. P., 1.

BROWN, L. W.

1. Increasing height of floods in the lower Mississippi; the problem and its solution. Engin. News, vol. 45, no. 16, pp. 280-283, Apr. 18, 1901.

Gives velocities of flood flows, noting experiments by Bazalgette on velocities required to move various materials and observations of hydraulicians relative to velocities needed to abrade river banks and beds. Discusses effect of levee system, changing of bed of river, and accretions forming on bottom and sides of channel at apex side of bends on retardation of velocities, which cause excessive accretions and increased flood heights. Offers solution. Describes a proposed method of reclaiming waste swamp by the use of a reservoir system, noting that deposits on land would amount to 6,347,000 acre-feet in 100 yr.

Discussion: W. J. HARDEE, pp. 378-381, takes exception to Brown's views that the carrying capacity of the Mississippi River is decreasing. Criticizes the methods employed in measuring the discharge of the river. Discusses conditions of sediment transportation and deposition and changes in stream cross-sections. Quotes Col. Derby, Corps of Engineers, U. S. Army, relative to the effect of levees in increasing flood heights. States in conclusion that the apparent increase in flood height at high stages is not due to the rise of the river bed nor to crevasses, and that the carrying capacity of the Mississippi is increasing.

2. The protection of cities in the Mississippi Valley against the encroachment of the river. Engin. News, vol. 45, no. 24, pp. 427-429, illus. June 13, 1901.

Considers relative merits of spur dike and mattress method of bank protection, causes of river bank caving, and conditions which increase rate of bank caving on the Mississippi River. Describes accretions on river bed due to retarded velocities which cause reduction in channel cross-section and an increase in velocity resulting in subsequent bank abrasion and caving. Notes that bank reinforcement would prevent abrasion and cause scour of deposits in bed. Change of direction of flow caused by abrading banks results in eddies, crosscurrents, and whirlpools, in turn causing scour and further bank caving. Describes works to prevent abrasion of river banks by spurs and mattresses comparing relative merits of each.

BROWN, LESLIE A. See Mitchell, B. T., 1.

BROWN, LYTLE. See also Matthes, G. H., 6.

1. Flood control work on the Mississippi. Sci. Monthly, vol. 30, pp. 481-499, illus., June 1930.

Describes levee construction, bank revetment, spillways, etc. Notes that the fertility of some lands in the Mississippi Valley has deteriorated due to protection works which prevent overflow and silt deposition.

BROWN, M. H.

1. Traveling soils. Soil Conserv., vol. 2, no. 11, pp. 252-253, illus., May 1937.

Describes the disastrous results of the Ohio River flood (1937). Outlines the initiation of a survey by the Section of Conservation Surveys and the Section of Sedimentation Studies, U. S.

Soil Conservation Service, to study the effect of this flood on farm lands and urban areas from Pittsburgh, Pa., to Cairo, Ill. Factors recorded on survey maps are: (1) Estimated amount of deposit or removal, (2) nature of deposits or estimated removals, and (3) land use of cover. Offers general comments based on field observations. Gives description of flooded zone noting that main silt load was carried in locality of strongest current following regular channel. Deposits on wide flood plains rarely exceeded 3/8-1/2 in. in depth; in vicinity of large bends, uniform deposits of 1/2-2 1/2 in. of silt and silty clay were found. Sand deposits on bottom lands ruined, for agricultural purposes, the best soils of the valley. In gorge-like areas of the valley, sand deposits up to 6 and 7 ft. in depth were observed. Describes the removal of soil from fields by cutting action of flood water. Notes the effects of the flood in tributary valleys.

BROWN, ROBERT MARSHALL.

1. The movement of load in streams of variable flow. Amer. Geog. Soc. Bul., vol. 39, no. 3, pp. 147-158, Mar. 1907.

Deals with the movement of detritus and the regulation of low-water channels by confinement and by dredging in streams of variable flow. Wave-like movement of river bottom is described, noting form of wave, size, rate of progression, mode of movement and effect of velocity on form (Mississippi River Commission Report of 1882). Discusses building up of river beds on the Mississippi, Rhine, Po, and Hoang Ho Rivers. Summarizes results of an observation by the Scour and Fill Survey on the nature and extent of changes occurring in the bed of the Mississippi River from a bend of the river at New Madrid, Mo. to a point six miles below. Discusses regulation of low-water channels by confinement, canalization, and dredging. Considers location of deposits in meandering rivers.

2. The effect of levees on the height of the river bed. Amer. Geog. Soc. Bul., vol. 46, no. 8, pp. 596-601, 1914.
Discusses the effect of levees upon sediment transportation and deposition. States that levees do not affect bed levels, natural aggradation of river beds will not be affected by levee construction, increase in delta building rate due to levees results in slight river bed deposition, and removal of some sediment from streams will minimize deposits and increase scouring power of stream.
3. The utilization of the Colorado River. Geog. Rev., vol. 17, no. 3, pp. 453-466, illus., July 1927.
Deals with the utilization of the Colorado River for irrigation and water power purposes. Includes two paragraphs noting that the stream at Yuma has a silt content of approximately 0.6 percent of its volume, causing reduced velocities in irrigation canals due to silt deposits which require constant use of desilting measures. A series of dams on the stream would overcome the difficulties involved in the silting up of canals, whereas a single reservoir, if used as a catch basin, would probably silt up in a few years thereby, affecting its capacity.

BROWN, W. G. See Fristoe, R. E., 1.

BROWNE, WALTER R.

1. The relative value of tidal and upland waters in maintaining rivers, estuaries, and harbours. Inst. Civ. Engin., Minutes of Proc., vol. 66, pp. 1-28, illus., 1881.
Paper deals with the relative value of the tidal flow and of the fresh water flow in preserving the full depth and section of the channels of tidal rivers and estuaries.
Discussion: HENRY J. MARTEN, pp. 76-78, comments on the source, amount, and conditions of transportation and deposition of sediment in the River Severn. Notes the possibility that shoal areas in the tidal portion of the stream could be warped up by the upland deposits and be converted into sound agricultural land.

BRUCE, DUFF WILLIAM.

1. The port of Calcutta. Engineering, vol. 34, pp. 1-3, illus., July 7, 1882.
Describes the port of Calcutta on the Hooghly River. Discusses "bores" caused by flood tide; tides, channel conditions, bank protection works, etc. Notes that during dry weather the river is almost free of silt while in the rainy season the quantity of solid matter averages 1 cu. in. to 1 cu. ft. of water and in heavy floods as much as 3 cu. in. to 1 cu. ft. of water.
2. The port of Calcutta. Engineering, vol. 34, pp. 128-129, illus., Aug. 11, 1882.
Describes works at the port of Calcutta. Discusses the effect of jetties on silting, removal of silt by dredging and washing, proposed reclamation behind jetties, and construction of embankment.

BRUCE, J. C. See Besley, F. W., 1.

BRUNE, GUNNAR M. See also MADDOCK, T., Jr., 1.

1. (and Allen, R. E.). A consideration of factors influencing reservoir-sedimentation in the Ohio Valley region. Amer. Geophys. Union, Trans., vol. 22, pt. 3, pp. 649-655, illus., Aug. 1941.
Paper presents results of a study which is an attempt to evaluate some of the factors influencing rates of reservoir-sedimentation especially in the Ohio Valley region. The principal factors influencing rates of silting of reservoirs are noted. This study considers only two of the most important factors: rate of erosion and ratio of capacity to drainage area. The method of operation of the dam is also considered since all reservoirs studied were of the same general type. Results are presented graphically for the 23 reservoirs studied, 11 in the Ohio River Valley region and 12 in other parts of the country. The study provides an indication of the range of magnitude of silting to be expected for permanent-storage reservoirs, but results should be used in association with other evidence to predict rates of silting in particular reservoirs.
2. Reservoir silting in the Ohio Valley. U. S. Soil Conserv. Serv., Ohio Valley Region, Tech. Notes 18, 2 pp., Oct. 1941.
Presents tabulated data on rates of silting of 23 reservoirs in the Ohio River Valley; notes that information may be of value in planning construction of stock ponds.
3. Island-formation and channel-filling on the upper Wabash River. Amer. Geophys. Union, Trans., vol. 23, pt. 2, pp. 657-663, illus., 1942.
A study made to determine to what extent the upper Wabash River is filling or enlarging its channel, to evaluate the effects of this process on flood-frequencies, and to determine possible cause of the phenomena observed, covered the portion of the river between Huntington and Lafayette. Points out that the sediment which forms islands and other channel-fill deposits is derived mainly from channel enlargement in smaller upstream tributaries, and less from the erosion of highway banks and cultivated fields.
4. Effects of soil conservation on reservoir sedimentation in the southeast. Jour. Soil and Water Conserv., vol. 2, no. 2, pp. 103-105, 108, illus., Apr. 1947.
Presents the need for a study of rates of silting in given reservoirs before, during, and after treatment of the drainage areas with soil-conserving measures in order to show how much a soil-conservation program will reduce sedimentation. This report presents a study of the apparent reduction in rate of silting that has taken place at the High Point, N. C., Newnan, Ga., and Roxboro, N. C., reservoirs in an attempt to determine the magnitude of the reduction that may be expected from a well-planned soil conservation watershed treatment program.
5. The sediment problem in the Midwest. Upper Miss. Water Use Council, Proc. 12, pp. 29-38, July 17, 1947.
Discusses various types of sediment damage which occur in the Midwest, sources of sediment, and remedial measures.

6. Whose problem is soil erosion? Jour. Soil and Water Conserv., vol. 2, no. 4, pp. 175-178, illus., Oct. 1947.

Shows damages caused by soil erosion. Lists figures which show the cost of dredging reservoirs and stream channels, and shows how soil conservation can reduce such costs.

7. Rates of sediment production in midwestern United States. U. S. Soil Conserv. Serv. SCS-TP-65, 40 pp., illus., tables and graphs, Aug. 1948. Summarizes available records for the Midwestern States comprising the upper Mississippi, Ohio, and Great Lakes drainage basins. Compiles, evaluates, and translates into comparable units all the data considered usable in estimating quantities of sediment carried by streams in this region. Gives data on suspended-load measurements and reservoir sedimentation surveys for the area. Notes the comparative value of various types of measurement. Comments on long-term rates of sediment production; gives present rates and prediction of long-term rates.

8. Reservoir sedimentation in limestone sinkhole terrain. Agr. Engin., vol. 30, no. 2, pp. 73-77, illus., Feb. 1949.

Deals with the amount, character, and distribution of sediment deposition in Spring Mill Lake, Mitchell, Ind. Treats the sources of sediment and gives possible remedial measures. Discusses rates of sediment production which might be expected in the Highland Rim physiographic province.

9. A comparison of sediment loads carried by the Missouri and upper Mississippi Rivers. Amer. Geophys. Union, Trans., vol. 30, no. 3, pp. 396-400, illus., tables and graphs, June 1949.

This report is a comparative study of the sediment load carried by the Missouri and upper Mississippi River. Corrections are made for the type of sampler used, bed sediment, and abnormal runoff. Notes that, at the confluence of the rivers, the long-term sediment concentration of the Mississippi is 20 percent of that in the Missouri, the mean annual rate of sediment production per square mile of drainage area for the Mississippi is 84 percent of that of the Missouri. Points out that the rate of sediment production of the Mississippi is 4.2 times as great, relatively, as its sediment concentration when compared to the Missouri. This is due to the annual runoff per square mile in the upper Mississippi basin averaging 4.2 times that of the Missouri basin. Sedimentation concentration and rate of sediment production for these two rivers increase with increasing size of drainage area up to 200,000 sq. miles. Includes a table giving data on suspended load for various stations.

BRUSH, C. B. See Spielmann, A., 1.

BRUSH, W. W.

1. Coagulant being used to reduce turbidity in New York water. Engin. News-Rec., vol. 98, no. 3, p. 112, Jan. 20, 1927.

Considers the turbidity of water in Ashokan Reservoir, Catskill Mountains, N. Y., part of the New York City water-supply system, due to erosion of clay banks in the Esopus Creek watershed during flood. By treating the water with alum above Kensico Reservoir in the aqueduct between Ashokan and Kensico Reservoirs, the turbidity was effectively reduced.

BRUUN, PALLE.

1. Action of waves and currents. Ingeniøren, vol. 18, pp. 275-281, 1909; [abstract], Inst. Civ. Engin., Minutes of Proc., vol. 179, pp. 414-415, 1910.

Describes various phenomena involved in wave and current action and discusses the energetics of the transportation and deposition of suspended and bottom materials.

BRYAN, KIRK. See also Hardin, G. C., Jr., 1; La Rue, E. C., 2; Taylor, T. U., 6.

1. Erosion and sedimentation in the Papago country, Arizona. U. S. Geol. Survey Bul. 730, pp. 19-90, illus., 1923.

Discusses the geology and physiography of the Papago country. Gives a detailed discussion of stratigraphy and structure under Geology.

Under Physiography, discusses the influence of aridity, mountain sculpture, mountain pediments, and valleys. Outlines the geological and physiographic history. Treats of channel cutting; notes that rapid cutting began in the eighties.

2. Geology and ground-water resources of Sacramento Valley, California. U. S. Geol. Survey, Water-Supply Paper 495, 285 pp., illus., 1923.

Deals with the geology and groundwater resources of Sacramento Valley, Calif. Includes discussion on the relation of topographic form to the regimen of streams; describes simple and coalescing fans, channel ridges, and valley flood plains of the Sacramento. Factors governing the transportation and deposition of silt, and conditions of natural levee formation are considered. Describes the channels and flood plains of the Sacramento and Feather Rivers. Outlines process of deposition of younger alluvium by the Sacramento River and its tributaries.

3. The Papago country, Arizona. U. S. Geol. Survey, Water-Supply Paper 499, 436 pp., illus., 1925.

Includes a general description of the geology and physiography of the Papago country, Ariz. Considers the formation of pediments, the physiographic processes of transportation and deposition of sediment, sources of water, channel trenching, and reservoirs. Comments on detritus-filled reservoirs and artificial springs.

4. Date of channel trenching (arroyo cutting) in the arid Southwest. Science n. s., vol. 62, no. 1607, pp. 338-344, Oct. 16, 1925.

Discusses the formation of arroyos in southern Colorado, northern New Mexico, northern Arizona, southern Utah, and southern New Mexico. Cites opinions of several authorities, and recommends further systematic research on the subject.

5. Channel erosion of the Rio Salado, Socorro County, New Mexico. U. S. Geol. Survey Bul. 790-A, pp. 17-19, 1926.

Presents historical evidence from surveys made in 1882 and 1918 on the changes in the channel of the Rio Salado, showing extent of channel erosion.

6. Recent deposits of Chaco Canyon, N. Mex., in relation to the life of pre-historic peoples of Pueblo Bonito. Wash. Acad. Sci. Jour., vol. 16, no. 3, pp. 75-76, 1926.

Notes development of Chaco Canyon on the southern border of San Juan Basin, N. Mex., which was initiated since the year 1870. Notes relics of man found in the canyon.

7. Silting of reservoirs; studies by engineers. Natl. Res. Council., Div. Geol. and Geog., Com. on Sedimentation, Rpt. (1925-26), pp. 88-94, 1926.

Discusses engineering problems associated with the estimation of the probable life of reservoirs located on sediment-bearing streams. Notes that the study involves stream-flow and sediment-content determinations, adequate silt-sampling apparatus, volume-weight determinations of deposited silt, conditions of silt distribution in reservoirs, and compaction conditions and porosity determinations of deposited silt. Bibliography.

8. Silting of reservoirs. Amer. Soc. Civ. Engin., Proc., pt. 1, vol. 53, no. 3, pp. 129-133, Mar. 1927.

Contains a bibliography of results of studies conducted by various engineers on silting of reservoirs. Discusses the problem of estimating the probable life of reservoirs on sediment-bearing streams of the United States from which quantitative results are attained. Notes studies on rolling load of streams; method of collecting samples to determine suspended load; and distribution, compaction, porosity and weight of deposited silt in reservoirs. Includes various estimates of weight of compacted silt which range from 50 to 100 lbs. per cu. ft.

9. (and LaRue, E. C.). Persistence of features in an arid landscape: the Navajo Twins, Utah. Geog. Rev., vol. 17, no. 2, pp. 251-257, Apr. 1927.

- Discusses effect of arid climate on erosion of two rock pillars known as the Navajo Twins near Bluff, Utah, on the San Juan River. Contains one paragraph on the violence of stream erosion. Cites an example of deepening of channel and widening and destroying of flood plain by lateral cutting on the San Juan River near the Navajo Twins as evidenced by the projection of an artesian well casing from the present sandy bed of the stream.
10. (and Robinson, H. F.). Erosion and sedimentation of the Zuni watershed, New Mexico [abstract]. *Amer. Geol. Soc. Bul.* 39, no. 1, pp. 158-159, Mar. 1928; *Pan-Amer. Geol.*, vol. 49, no. 1, pp. 70-71, Feb. 1928.
Describes studies on erosion and sedimentation in the Zuni watershed, N. Mex. Zuni Reservoir filled with an amount of silt equal to 69 percent of its original capacity in 22 yr. since 1906. Silt originates from open valleys of broad syncline of Cretaceous rocks at foot of mountains where production of waste rock has always been large, but since 1880 it has been accelerated by erosion of deep and ever-widening arroyos in broad valley floors. Enumerates causes of watershed erosion noting that mean silt content of water varies inversely with runoff. Notes that rapid filling of Zuni Reservoir was checked in 1923 by measures designed to control excessive erosion.
 11. Historic evidence on changes in the channel of the Rio Puerco, a tributary of the Rio Grande in New Mexico. *Jour. Geol.*, vol. 36, no. 3, pp. 265-282, illus., Apr./May 1928.
Describes changes in the channel, or arroyo, of the Rio Puerco since settlement in the region. Presents evidence that channel trenching began between 1885 and 1900 and that this process of accelerated erosion is continuing. Overgrazing as a cause of accelerated erosion (arroyo cutting) is discussed. Evidence is presented that similar arroyos were formed prior to 1880 and probably were due to "cyclic fluctuations in climate." Notes that the total quantity of mud and silt swept out of the Rio Puerco into the Rio Grande in 42 yr. is estimated at 394,882 acre-feet, or an average annual rate of 9,400 acre-feet, large portions of silt finding lodgement in Elephant Butte Reservoir.
 12. Silt studies on American rivers. *Natl. Res. Council, Reprint and Cir. Ser.* 92, pp. 34-48, 1929.
Summarizes results of studies by various investigators on the Colorado River, Ariz. and Tex., Rio Grande, N. Mex. and the Rio Puerco. Data are presented on the volumes of silt transported; rates of sedimentation in Zuni, McMillan, Elephant Butte, Roosevelt, Old and New Lake Austin, Lake Penick, Lake Worth, and Buckhorn reservoirs; volume-weight relationship of deposited silt; distribution of silt in reservoirs; silt underflow phenomena in reservoirs; relation of specific gravity of silt to delta building at the heads of reservoirs; and bed-load movement in streams. Recalculates the rate of silting in a reservoir of the Colorado River based on various weights of dry silt per cubic foot. Describes regimen of the Rio Puerco, watershed characteristics, conditions of arroyo formation and channel erosion, and silt contributions to the Rio Grande. Notes works designed to prevent excessive erosion of and to retain silt on the watershed. Describes briefly methods of silt control on the Zuni watershed.
 13. Silt studies in 1928 and 1929. *Natl. Res. Council, Reprint and Cir. Ser.* 98, pp. 27-29, 1931.
Summarizes results of silt studies (Follansbee, R., 2, Howard, C. S., 2; and Young, J. M., 1). Annual silt loads of the Colorado River near Kremmling, Palisade, and Cisco, Utah, and at Whitewater are given, noting that wooded character of the upper Colorado watershed accounts for low quantity of transported sediment (Follansbee). Describes sampling apparatus and method of sampling at Grand Canyon and Topock. Maximum and minimum silt contents in the Colorado at Grand Canyon were 13.83 and 0.03 percent respectively. Discusses volume-weight relationship of deposited silt (Howard).
 14. Gully gravure - a method of slope retreat. *Jour. Geomorph.*, vol. 3, no. 2, pp. 89-107, Apr. 1940.
Describes a recurrent cycle of processes by which steep slopes of hills and mountains retreat; the process depends on special conditions. This process of slope reduction is termed "gully gravure." A pervious mantle inhibits runoff and may bring about a shift in position of gullies on a slope, as demonstrated in the Jemez Mountains, N. Mex. By such shifts in the position of the gullies, the slope retreats.
 15. Erosion in the valleys of the Southwest. *N. Mex. Quart.*, vol. 10, no. 4, pp. 227-232, Nov. 1940.
Discusses problem of arroyo cutting in southwestern United States. Points out that there have been at least three alternate periods of cutting and deposition. The last period of channel cutting, which is still active, began since 1880. Attributes arroyo cutting mainly to fluctuations in climate and states that over-grazing is merely a trigger force which precipitated the most recent event of arroyo cutting.
 16. Geologic antiquity of man in America. *Science n. s.*, vol. 93, no. 2422, pp. 505-514, May 30, 1941.
Presents general considerations upon methods of interpreting the age of Folsom and pre-Folsom native cultures in North American historical ethnology. Some five paragraphs (pp. 513-514) afford observations on erosion and alluviation in valleys of the Southwestern States during the earlier periods of human occupancy.
 17. Pre-Columbian agriculture in the Southwest as conditioned by periods of alluviation. *Assoc. Amer. Geog. Ann.*, vol. 31, no. 4, pp. 219-242, Dec. 1941.
Describes agricultural practices of the Pueblos in the Southwest and discusses the effect of alternate periods of erosion and alluviation upon these practices; erosion and sedimentation on flood plains and in stream channels; and growth of arroyos. Gives estimates of erosion and aggradation.
- BRYAN, R. P. See Pyritz, H. W., 1, 2.
BRYANT, E. O. See White, A. M., 1.
BUCHANAN, SIR GEORGE CUNNINGHAM.
1. The Rangoon River-training works [abstract]. *Engineering*, vol. 101, pp. 299-300, illus., Mar. 31, 1916.
Describes training works on Rangoon River made necessary by existence of a sand bar, and serious erosion of right bank which threatened to divert the channel and cause silting up of the Port of Rangoon. Discusses proposed training works and construction of training walls. Gives results of work, noting that channel was restored to original position with proper navigable depth; also notes diminution of sand banks, deposition of silt inside of embayment at average rate of 16 in. monthly, and that continuous dredging was made unnecessary.
- BUCHANAN, J. E.
1. Practice and experiments utilizing asphalt - water control and erosion prevention. *Asphalt Inst. Construct. Ser.* no. 43, pp. 14-23, illus., Aug. 1, 1938.
Deals with the use of asphalt in the construction of water-control and erosion-prevention engineering works. Describes effectiveness of asphalt paving or spillway structures of debris basins and cites examples of asphalt utilization in bank protection works in the Los Angeles County Flood Control District.
- BUCHER, WALTER H.
1. On ripples and related sedimentary surface forms and their paleographic interpretation. I. The origin of ripples and related sedimentary forms. *Amer. Jour. Sci. (ser. 4)*, vol. 47, no. 279, pp. 149-210, illus., Mar. 1919.
Discusses subaqueous current ripples; current velocities necessary to move debris of different sizes; appearance of rippling rhomboid ripples; data on profile, movement, wave length and amplitude of current ripples; the formation of current ripples; linguoid ripples; sand waves and related surface forms; second critical point of current velocity; appearance of

and data on regressive sand waves; sand waves in rivers; appearance of and data concerning large sand waves in rivers; exposure of large ripples after high water along streams and tidal flats; formation of sand waves; oscillation ripples; compound ripple patterns; Eolian ripples and dunes. Bibliography.

BUCK, SIR EDWARD CHARLES.

1. The agricultural resources of India. Soc. Arts, Jour., vol. 33, no. 1680, pp. 225-235, Jan. 30, 1885.

Discusses the various aspects of the agricultural resources of India. Notes effects of monsoons on the agricultural resources, and points out ways to increase agricultural productivity.

Discussion: MR. WILSON, pp. 235-236, describes experiments conducted by the Agricultural Department of North-West Province, India, in utilizing canal silt to a depth 12-18 in. on oosa plains to increase fertility of the soil. Results are given.

2. The applicability to India of the Italian method of utilizing silt. Soc. Arts, Jour., pp. 734-743, May 31, 1907.

A technical paper given before the Indian Section of the Society of Arts on May 2, 1907. Gives historical information on the use of silt in building and improving land (colmatage) in various countries. Outlines some of the work done in Italy which was begun in the 12th century with amelioration of the historical Val di Chiana. First to study the silt deposit which resulted in the reclamation of Val di Chiana was Torricelli, pupil of Galileo. Estimates that 5,000 sq. miles or 1/20 of the total area of Italy, will sooner or later be built up by silt. Describes large tracts in India where land improvement by colmatage may be carried out economically.

Discussion: SIR CHARLES A. ELLIOTT, pp. 743-745, comments on the difficulties of applying Italian methods of land Bonificazione to India, noting the cost, the lack of trained personnel and means of training them, and the lack of fertility of some of the silts available. The value of built-up land in eliminating sources of malaria is noted. Need for cooperation and private initiative by individual landowners is stressed. Note is made of the tank systems of Madras and Mysore, the marshlands of eastern Bengal, and conditions along the Rivers Jumna, at Delhi, Ganges, at Cawnpore and Farukhabad, Isan, in the Cawnpore district, and Limone, in the Ravenna district, Italy.

J. A. VOELCKER, pp. 745-746, deals with the fertilizing value of silt and notes the factors to be considered in determining whether its use is advantageous from an agricultural point of view. R. B. BUCKLEY, pp. 746-747, comments on the quantity of silt in Indian rivers and canals and the increased value of land built up by fertile silt. Reference is made to the Sone Canals in Behar, land reclaimed by silt near Patna, and close to Bankipur on the Ganges, the Indus River, the Chenab Canal in the Punjab, canals in the South of the Punjab and in Sind, canals in the Moselle district in France and the Nile River in Egypt. Cost of canal construction and maintenance are noted. T. H. MIDDLETON, p. 748, comments on the skill required to operate and utilize silt retention works in India. J. D. ANDERSON, pp. 748-749, comments on conditions in central and eastern Bengal, India, with regard to utilization of river silt in building fertile land. The section called Khaliajuri on the Kangsa River in eastern Bengal built up in 100 yr. Now villages are built on islands and the intermittently flooded lowlands are cultivated to rice and marsh grass. Central Bengal conditions are less favorable but more closely resemble the valley of the Po and tracts in Japan. Rivers now are retained between high dikes and subject to occasional destructive floods. By careful engineering this inundation can be controlled and planned in advance so as to build up land now protected by dikes. THE AUTHOR, p. 748, notes the quadrupling of the value of land near

Cawnpore, India, by preventing escape of old silt and by retaining new silt. Further study of reclamation of land by river silt in India, applying Italian methods, is recommended.

3. Report...on the control and utilization of rivers and drainage for the fertilization of land and mitigation of malaria. 19 pp. n. p., 1907; [abstract], All-India Sanit. Conf., Lucknow, Proc. 3, pp. 20-22, 1914.

Consists of a description of silt utilization for land fertilization in Italy, including costs, results achieved, and extent. Comments on the campaign against malaria by the agency of silt deposit combined with drainage. Recommends similar work in India.

BUCKHAM, A. F.

1. [Review of] Splitting the minus-200 with the Superpanner and Infraserizer, by H. E. T. Houltaing. Jour. Sedimentary Petrology, vol. 8, no. 1, pp. 36-37, illus., Apr. 1938.

Reviews an article (Houltaing, H. E. T., 1) which presents important information on the analysis of fine-grained sediments. Notes the development of the Superpanner and Infraserizer and their use.

BUCKLEY, ARTHUR BURTON. See also Rothery, S. L., 2.

1. The influence of silt on the velocity of water flowing in open channels. Inst. Civ. Engin., Minutes of Proc., vol. 216, pp. 183-211, illus., 1923; [abstracts], Canad. Engin., vol. 45, no. 14, p. 374, Oct. 2, 1923; Engineering, vol. 115, no. 2984, p. 311, Mar. 9, 1923.

Discusses experiments conducted on the Nile River to determine the influence of silt on the velocity of water flowing in open channels. Puts forward a new formula, which includes a silt factor, to compute the velocity of the Nile from observations of slope at the Beleida discharge station; this formula is known as the Beleida formula. Describes the Buckley-Wilson discharge recorder. Contends that, all other factors being equal, the velocity of flow in a given section is increased by the presence of silt in the water.

Discussion: MURDOCK MACDONALD, pp. 213-214, comments on the problem of water discharge and the silty stage. W. C. UNWIN, pp. 217-219, notes the question of the deposition of a slurry and its velocity and the need for some vertical velocity curves for a given gauge level in clear and silted water. S. M. DIXSON, pp. 219-221, comments on Mr. Buckley's paper and points out that experiments by G. K. Gilbert show that the presence of silt in running water tends to reduce the velocity. J. S. BERESFORD, pp. 227-229, deals with protecting a bed from scour by using sail cloth; notes also various inconsistencies in Mr. Buckley's paper. R. W. WESTERN, pp. 230-231, treats Mr. Buckley's inference that the discharge of the Nile is augmented when silt is present. THE AUTHOR, pp. 233-249, makes various remarks concerning comments put forth by discussers and notes additional facts concerning the problem. A. D. BUTCHER, pp. 253-256, makes various remarks concerned with the effect of silt on velocity. HERBERT CHATLEY, pp. 256-257, observes that a partial explanation of the variation of discharge with silt might be found in changes of viscosity and density, and the ratio of the two on the kinematic viscosity. H. E. HURST, pp. 257-264, gives various data concerned with the silt affecting the velocity of flowing water. F. E. KANTHACK, pp. 264-266, comments on the Beleida formula and various factors dealing with the problem. E. S. LINDLEY, pp. 268-280, gives various facts from Punjab experiences which pertain to the effect of sediment in suspension on velocity. W. T. OLIVE, p. 280, notes that an admixture of silt increases the velocity because wet clay is a lubricant. S. L. ROTHERY, pp. 282-283, comments on the precipitation of slurry along the periphery of a canal due to retarded velocity and to friction of canal sides, and raises the question whether such precipitation would be continuous along the whole wetted surface of the canal and would reduce the

cross-section area so as to stop flow conditions. Notes that Kennedy's non-silting canals have saved much money. W. H. THORPE, pp. 283-284, comments on the difficulty of accepting the idea of the influence of silt in discharge quantities. THE AUTHOR, pp. 290-298, makes comments on points brought out by discussers and gives additional data to substantiate his contentions on the influence of silt on the velocity of flowing water. Notes the concordance between the conclusions of Mr. Duponchel, Mr. Gilbert, and the author. ANONYMOUS, (Indian Engin., vol. 75, no. 15, pp. 206-208; no. 16, pp. 223-224; no. 17, pp. 234-235; no. 18, p. 249; no. 19, pp. 262-263; no. 20, pp. 276-278, Apr. 12-May 17, 1924), comments on Buckley's theory relative to the effect of a blanket of slurry interposed between a current of water and the bed of the stream upon the velocity of the current. Describes the Buckley-Wilson discharge recorder which was used to make observations at Baqlavis, Khannaq, and Beleida in the Nile. Makes various comments on experimental observations presented on the paper.

BUCKLEY, ROBERT BURTON. See also Buck, Sir E. C., 2.

1. Stream dredging in India. Engineering, vol. 28, pp. 157-159, illus., Aug. 22, 1879.
Gives detailed description of dredger used by the Government of Bengal for clearing out silt which annually blocks heads of Indian canals, results obtained, mode of operation, material dredged, costs, etc.
2. Movable dams in Indian weirs. Inst. Civ. Engin., Minutes of Proc., vol. 60, pp. 43-55, 1880; [abstract], Engineering, vol. 29, p. 102, Jan. 30, 1880.
Describes weirs on Mahanuddee and Cossye Rivers with movable parts so that the silt supplied from rivers above weirs and other deposits could be swept away from heads of canals. Gives description and operation of the Sone weir.
3. On keeping irrigation canals clear of silt. Van Nostrand's Engin. Mag., vol. 22, no. 133, pp. 26-28, Jan. 1880.
Four methods of excluding silt from irrigation canals are discussed.
4. Irrigation works in India and Egypt. 348 pp., illus. New York, Spon and Chamberlain, 1893.
Considers the principles which regulate irrigation engineering in India and Egypt. Describes the inundation canals in India and Egypt, considering methods of exclusion of silt from the canals, selection of sites for the heads of canals, factors affecting silting, and the fertility of silt in irrigating waters. Discusses various aspects of the problem of sediment transportation and deposition, giving brief data on the quantity of silt in, and quantity of solid matter transported to the sea by, various rivers; on rate of silt deposit; on silt exclusion from irrigation works; on canal design to insure adequate conditions of silt transportation; on clearance of silt deposits from canals; on silting up of borrow pits; on effect of groynes in canals; on action of silt in sealing canal beds; and on methods of preventing silt deposits in reservoirs. Describes the perennial canals in deltaic tracts, pointing out the necessity for embanking the margins of the natural channels; the delta regimen of streams; the effects of embankments on stream regimen in delta areas; and land reclamation by embankments. Discusses various factors to be considered in the proper selection of site and design of canal headworks to prevent scour and deposition at the weirs.
5. The irrigation works of India. Ed. 2. 336 pp., illus. London, E. & F. N. Spon, 1905.
Discusses the need and problems of irrigation in India. Considers the various types of irrigation works in India. Considers the nature of silt, silt in different rivers, amount of silt carried to the sea by the Nile and the Indus, silt deposits in various canals in India, the use of brick and stone groynes to prevent silt.

Discusses the scouring of silt, the flushing of canals, Kennedy's method, and the prevention of silting in canals.

6. The design of channels for irrigation or drainage. 53 pp., illus. London, E. & F. N. Spon, Ltd., 1911.
Presents formulae which have been proposed for calculating the flow of water in open channels. Draws attention to Manning's formula, and discusses Kennedy's silt theory of non-silting channels.
7. Irrigation pocket book. 419 pp., illus. London, E. & F. N. Spon, Ltd., 1911.
A compilation of facts, figures, and formulas used in the everyday work of an irrigation engineer. Contains a chapter on silt which gives data on silt analyses in the following: Sirhind Canal, Sone Canals, the Mississippi River, the Sutlej River, the Guadalquivir at Cordoba, Spain, Bengal, Ganges, Godavari, Mahanuddee, Nile, Durance in France, and the Rio Grande in Mexico. Considers such subjects as weight of silt, silt carried to the sea by rivers, the use of boxes to determine depth of silt deposited in Bombay reservoirs, and the strengthening of canal banks by silt. Gives Kennedy's silt theory of non-silting or non-scouring channels, which states that channels do not silt or scour their beds when the mean velocity has a definite relation to the depth of water in the channel.

BUCKMAN, HARRY O. See Lyon, T. L., 1.
BUDENDAY.

1. Movement of bed load. In Schoklitsche, Armin. Der Wasserbau, pp. 343-357. Wien, Julius Springer, 1930. In German. Translation on file at the University of California, Berkeley, Calif., and at U. S. Soil Conservation Service, Washington, D. C.
Discusses bed-load movement and gives various equations. Comments on examination of a bed-load sample from the Rhine River, Germany. Conditions of bed-load movement are briefly noted for the Rhone, Oder, and Elbe Rivers.

BUHLER, ERNEST O.

1. Forest and watershed fires in Utah. Utah Agr. Expt. Sta., Cir. 115, 27 pp., illus., Mar. 1941.
Describes various forest and watershed fires in Utah and discusses the relationship between denudation of mountain watershed by fires and floods. Evidences of watershed damage are gully erosion on mountain sides, silted ditches, accelerated sheet erosion, and deposition of infertile flood debris on rich valley lands. Flood damages in Wellsville Mountain Area, Price River Communities, Willard Watershed, Salt Lake County, and Huntington Canyon due to mud and debris deposition, are described.

BULL, A. W.

1. (and Darby, G. M.). Sedimentation studies of turbid American river waters. Amer. Water Works Assoc. Jour., vol. 19, pp. 284-305, illus., Mar. 1928; [abstract], Engin. News-Rec., vol. 98, no. 24, p. 986, June 16, 1927.
Paper presented before the American Water Works Association, June 10, 1927 on sedimentation studies by the Dorr Company since 1923 on water of some turbid rivers of the middle west (Mississippi, Missouri, and Arkansas Rivers). Describes studies as to comparative clarification rates in short cylinders on untreated water and on water leaving grit chambers or preliminary basins, including the effect of adding sludge before clarification; determination of turbidities of various samples to determine relationship between turbidity and suspended solids, and to note effect on ease of clarification. Includes tabulation of suspended solids and corresponding turbidities, and clarification tests on treated river waters. Gives comparison of clarification tests in cylinders with clarification tests in a continuous clarifier. The tests indicate that detention in short cylinders agrees with actual clarifier operations while clarification tests in deep cylinders do not. Describes studies on sludge deposition, thickening and discharge, and studies of the advantages of sedimentation prior to flocculation in treatment of highly turbid water.

BULLARD, FRED M.

1. Source of beach and river sands on Gulf Coast of Texas. *Geol. Soc. Amer. Bul.*, vol. 53, no. 7, pp. 1021-1043, illus., July 1, 1942.

Tests the value of correlation based on heavy minerals in the sands now being deposited on the beaches of the Texas Gulf Coast. The various rivers carry a distinctive suite of heavy minerals. Collections of samples were made from the Nueces, Rio Grande, Guadalupe, Colorado, San Antonio, Brazos, Neches, and Trinity Rivers. Mechanical and heavy-mineral analyses were made of the sands. Various conclusions are given. Notes influence of rivers in the heavy mineral residues of Gulf Coast Beach sands.

BUREAU OF RECLAMATION. See U. S. Bureau of Reclamation; U. S. Reclamation Service.

BUREAU OF STANDARDS. See U. S. National Bureau of Standards.

BURKE, M. F. See Los Angeles Co., Calif. Flood Control District, 1.

BURKOV, A. F.

1. Regimen of silt at Dzoraghet hydroelectric plant. *Sci. Res. Inst. Hydrotechnics, Trans.*, vol. 13, pp. 164-191, illus., 1934. In Russian with English abstract. Translation on file at the U. S. Soil Conservation Service, Washington, D. C., and the University of California, Berkeley, Calif.

Presents results of investigations of the silt conditions at the Dzoraghet Hydroelectric Plant in Armenia. Summarizes the program of investigation and describes features of the Dzoraghet River watershed. Notes that volume of the reservoir was reduced 25 percent in 1 yr. (1932-33) due to silting; annual suspended load of the stream amounted to 400,000-500,000 tons and annual bed load to an estimated 14,500 tons. Describes mechanical characteristics of suspended and bed load. Results of operation of the structure to eliminate silt and hydraulic problems connected with the operation of a two-chamber settling basin of the plant, are briefly considered.

2. Silt at Zemo-Avchal hydroelectric plant on the Kura River. *Sci. Res. Ins. Hydrotechnics, Trans.*, vol. 11, pp. 96-137, 1934. In Russian with English abstract. Translation on file at the U. S. Soil Conservation Service, Washington, D. C., and the University of Minnesota, Minneapolis, Minn.

Describes silt conditions at the Zemo-Avchal hydroelectric plant on the Kura River near Tiflis. During 6 yr. of operation 60 percent of the volume of the upper pool has been silted; 30 percent of the volume of the daily pondage prism has also been silted. The reservoir is filled mainly by silt carried in suspension. In 5 or 7 yr. the reservoir will cease to exist because the bed load is moving toward the headworks at an excessive annual rate. Silt is injurious to turbines because of size and mineralogical composition. Unsatisfactory conditions for desilting are noted.

3. Some results of field investigations regarding silt-regimen at headworks of Malo-Kabardinskaya Irrigation System on the Terek River. *Sci. Res. Inst. Hydrotechnics, Trans.*, vol. 12, pp. 119-142, 1934. In Russian with English abstract. Translation on file at the U. S. Soil Conservation Service, Washington, D. C., and the University of California, Berkeley, Calif.

Presents results of field investigations regarding silt conditions at the headworks of the Malo-Kabardinskaya Irrigation System on the Terek River, U. S. S. R. Discusses silting problems relative to diversion on sluicing operations.

4. Results of field investigations of silting in upper pool and structures of Dzoraghet hydroelectric plant and their comparison with model experiments in hydroelectric laboratory. *Sci. Res. Inst. Hydrotechnics, Trans.*, vol. 18, pp. 183-201, 1936. In Russian with English abstract.

Compares field and model investigations of silting conditions at the Dzoraghet hydraulic plant. Notes that laboratory conclusions almost completely coincide with field observations. Gives conclusions regarding design of diversion structures on silt carrying rivers and design of desilting reservoirs.

BURMA. DEPT. OF AGRICULTURE.

1. Report of the agricultural stations for the year ended Mar. 31, 1934. 204 pp., illus. Rangoon, 1934. Presents results of various agricultural experiments carried out at the Mudon Agricultural Station during the year ending Mar. 31, 1934. Results of experiments on the fertility of silt are included (pp. 45-46).
2. Report of the agricultural stations for the year ended Mar. 31, 1935. 186 pp., illus. Rangoon, 1935. Presents results of various agricultural experiments carried out at the Mudon Agricultural Station for the year ending Mar. 31, 1935. Results of experiments on the fertility of silt are included (p. 48).

BURMISTER, DONALD M. See Campbell, F. B., 1.

BURNET, GEORGE.

1. The use and design of settling basins. *Agr. Engin.*, vol. 19, no. 11, p. 480, Nov. 1938. Discusses the use and design of settling basins in the Missouri Valley, Iowa. The problem of water at rapid velocities carrying suspended material from hilly land, depositing sediment in drainage ditches on bottom land is discussed. Notes that when basins are constructed below the entrance of ditches, the ditch above the basin silts up, e. g. Allen Creek silted in 3.5 miles above basin and required yearly cleaning, but when the settling basin ceased to function the ditch below it filled to a depth of approximately 3 ft. for 13.5 miles.

BURNS, B. F.

1. Board mattress for preventing scour in drainage channel. *Engin. and Contract.*, vol. 52, no. 11, p. 299, illus., Sept. 10, 1919. Describes a type of revetment used in a diversion canal of Little River Drainage District, Mo. to prevent scour due to high water velocities. Revetment consists of wooden board mattresses weighted down with stone.

BURNS, GORDON K.

1. Rearranging the Connecticut River by remote control. *Tech. Engin. News*, vol. 13, no. 3, pp. 51-58, illus., Apr. 1932. Results of tests and experiments in the Massachusetts Institute of Technology River Hydraulic Laboratory on a scale model of part of the Connecticut River at a sharp bend near Northampton, Mass. Gives causes and conditions of stream bank erosion at the bend. Stream bank protection measures are suggested by the study.

BURR, EDWARD. See Freeman, J. R., 3.

BURR, H. T.

1. A drainage peculiarity in Androscoggin County, Maine. *Amer. Geol.*, vol. 24, no. 6, pp. 369-371, Dec. 1899. Describes peculiar conditions of backward flow of the Androscoggin River into a chain of lakes above North Leeds. Conditions of delta deposition by reversed currents at the southernmost lake of the chain are described.

BURT, H. A.

1. Sand traps designed for streams with heavy bed loads. *Civ. Engin.*, vol. 16, no. 8, pp. 357-358, Aug. 1946. Paper based largely on developments by Parshall. Describes and presents plans of each of three practical designs of sand traps: Vortex tube, riffle deflector, and metal vane deflector.

BURTON, E. F.

1. (and Reid, B. M.). Determination of size of colloidal particles by means of alternating electric fields. *London, Edinb. and Dublin Phil. Mag. and Jour. Sci.* (ser. 6), vol. 50, no. 300, pp. 1221-1226, illus., Dec. 1925; [abstract], *Franklin Inst. Jour.*, vol. 201, no. 5, pp. 664-665, May 1926. Presents results of tests on a method for determining the size of colloidal particles in water using a vertical alternating electrical field to move particles up and down in a tube. Differences in rates of upward and downward movement in alternating-current fields make possible the application of Stokes' law from which the radius of the particle may be determined.

BUTCHER, ARTHUR DOUGLAS DEANE. See also Buckley, A. B., 1.

1. Investigations on questions relating to silt; recent work in Egypt. Internatl. Geod. and Geophys. Union, Sect. for Sci. Hydrol. Bul. 10, pp. 5-6, 1927.

Summarizes the nature of silt studies in progress at the Delta Barrage Research Station, Egypt.

2. (and Atkinson, John Dekeyne). The causes and prevention of bed erosion with special reference to the protection of structures controlling rivers and canals. Inst. Civ. Engin., Proc., vol. 235, pt. 1, pp. 175-222, illus., 1934; [abstract], Engineering, vol. 134, no. 3442, p. 709, Dec. 16, 1932.

Describes experiments which were started in connection with certain problems of erosion at the Sennor Dam controlling the Blue Nile, 200 miles south of Khartoum. Because of river-bed erosion below the dam, model experiments were made in order to determine control work for erosion prevention. Advocates the use of a model study for every major structure during the period of design so that the number of sluices, their grouping in bays, and their separation at bays or other points can be determined. Discussions and correspondence on the article are contained in pp. 223-278 in the same volume.

BUTCHER, R. W.

1. Biological balance in fresh water [abstract]. Water and Water Engin., vol. 34, no. 409, pp. 479-480, Oct. 20, 1932.

Paper read at a joint discussion held by the Zoology and Botany Sections of the British Association, Sept. 2, 1932. The effect of organic effluents on the biological balance in running water is given and the effect of the deposition of fine silt on the flora and fauna in running water is discussed.

CADELL, W. A.

1. A journey in Carniola, Italy, and France in the years 1817, 1818: 2 vols., illus. Edinburgh, A. Constable and Co., 1820.

Volume one includes several pages describing colmata or land building with river silt in the Val di Chiana.

CAJORI, FLORIAN. See Newton, I., 1.

CALDWELL, D. H.

1. (and Babbitt, H. E.). The flow of muds, sludges, and suspensions in circular pipes. Amer. Inst. Chem. Engin., Trans., 1941, vol. 37, no. 2, pp. 237-266, illus., 1942; also in Indus. and Engin. Chem. Indus. Ed., vol. 33, no. 2, pp. 249-256, illus., Feb. 1941.

Presents a theoretical analysis of the flow of sludges in a circular pipe. Notes two types of flow depending on velocity; these have been termed "plastic flow" and "turbulent flow." Develops equations for determining friction losses for plastic flow and turbulent flow; also gives an equation for the critical velocity, the velocity at which plastic flow changes to turbulent flow. Describes methods of determining significant constants in plastic flow and critical velocity equations.

CALDWELL, JOSEPH M.

1. Supersonic sounding methods, instruments and methods [abstract]. Civ. Engin., vol. 19, no. 5, p. 328, May 1949.

A report presented at the ASCE Hydraulics Division meeting at Oklahoma City which describes the use of echo-sounding electronic equipment in harbor work. Gives a description and method of operation of the equipment.

CALDWELL, P. H. See Wilson, W. E., 1.

CALIFORNIA DEBRIS COMMISSION.

1. The debris problem in the Sacramento Valley [abstract]. Engin. Rec., vol. 42, no. 21, pp. 491-492, Nov. 24, 1900.

Deals with works to prevent injury to navigation in the Sacramento Valley, Calif., by quantities of gravel, sand, and silt with which hydraulic mining operations have overloaded river beds. Notes that detritus consists of varying grades of material each following different laws of transportation by water. Finer material is capable of forming fertile soils. The project on the Yuba River contemplates the storage of

detritus in the river bed by works designed to separate coarse material from fine, and the restriction of the low-water channel within narrower limits to preserve deposits in place in the river below. Gives technical details of the proposed construction of retaining barriers and a settling basin provided with weirs and conduits to regulate the flow and cause the deposition of finer material carried in suspension, also details of training works to confine the river within well-defined lines.

2. Report...with regard to future operations for control of mining debris, improving navigability, and providing for control of floods on the Sacramento and Feather Rivers, California. U. S. Engin. Dept., Rpt., pt. 3, pp. 2262-2269, 1907.

Reports methods of controlling mining debris, improving navigability, and providing for control of floods on the Sacramento and Feather Rivers, Calif. The plan already adopted requires impounding of tailings by each miner on his own land. Considers the feasibility of applying to the Yuba, Bear, and American Rivers the described methods of protecting streams from mining debris.

CALIFORNIA, DEPT. OF ENGINEERING.

1. Fourth biennial report, December 1, 1912 to November 30, 1914. 285 pp., illus. Sacramento, State Print. Off., 1914.

Report of the California Department of Engineering for the period December 1912 to March 1914. Includes discussion on the debris problem in the Sacramento Valley and presents briefly results of a survey by the California Debris Commission (1913) made to determine the extent of debris movement in the Yuba River since previous surveys were made, and to furnish information necessary for planning control works.

2. Fifth biennial report, December 1, 1914 to November 30, 1916. 208 pp., illus. Sacramento, 1917.
3. Water resources of Kern River and adjacent streams and their utilization. Calif. Dept. Engin. Bul. no. 9, 209 pp., illus., 1920.

Presents results of field investigations and study of data relating to the water resources of that portion of the San Joaquin Valley adjacent to the Kern River. Includes discussion on engineering details of the proposed Isabella Reservoir; notes briefly anticipated silt conditions in the reservoir.

4. Seventh biennial report, 1919-1920. 151 pp., illus. Sacramento, 1921.

Notes the debris influx in the Sacramento River and its injury to navigation and control. Considers the choked condition of the Calaveras River and the Mormon Channel, and describes the bank-protection works on the Sacramento River at the Edinger-Johnson Levee.

CALIFORNIA, DEPT. OF PUBLIC WORKS. DIVISION OF ENGINEERING AND IRRIGATION.

1. Report...to accompany the third biennial report of that Department November 1, 1926. 66 pp., illus. Sacramento, 1927.

Report of operations of the Division of Engineering and Irrigation, Department of Public Works, California for the biennium ending November 1, 1926. Describes bank protection works constructed by the Division on the Sacramento during 1925-26 (pp. 37-39).

CALIFORNIA, DEPT. OF PUBLIC WORKS. DIVISION OF WATER RESOURCES.

1. South coastal basin investigation. Geology and ground water storage capacity of valley fill. Calif. Dept. Public Works. Div. Water Resources, Bul. no. 45, 279 pp., illus., 1934.

A report presenting results of an investigation in the South Coastal Basin, California, to determine (1) the geological conditions, including the nature of the ground water basin boundaries, the physical character of the basins and their relation to the occurrence and movement of ground water; and (2) storage capacity estimates for each basin. Includes discussion on the character of the alluvial gravels, sands, and clays in the basin.

CALIFORNIA, HYDRAULIC MINING COMMISSION.

1. Report upon the feasibility of the resumption of hydraulic mining in California. A report to the Legislature of 1927. 85 pp., illus. Sacramento, Calif., State Print. Off., 1927.

Presents results of an investigation relative to the practicability of the resumption of hydraulic mining operations in California. Includes brief discussion on settlement behind dams and consequent relative turbidity of overflow, and on the value for flood control of the restraining of natural debris. Brief data are given on sediment in samples from some rivers.

CALIFORNIA, OFFICE OF STATE ENGINEER.

1. The promotion of drainage, including river improvement and storage of mining detritus. In California. Office of the State Engineer. Report to the Legislature of the State of California, Session of 1881, Pts. II-III, pp. 1-95. Sacramento, J. D. Young, Supt. State Print., 1881.

Report on drainage promotion in California, the improvement of the Sacramento River, and the storage of mining detritus behind brush dams of the Yuba and Bear Rivers. Includes brief discussions on the flow of mining detritus in the Sacramento Valley; the anticipated operation of the dams, and retention of the sands in them; and the estimated annual rate of sand and gravel deposition behind the dams.

CALLAHAN, E. P. See Lucas, B. F., 1.

CALLAWAY, C.

1. On a cause of river curves. Geol. Mag. (decade 4), vol. 9, no. 10, pp. 450-455, illus., Oct. 1902. Attributes the divergence or formation of curves in rivers to the deposition of sediment by their affluents.

CALMELS, MARTIN.

1. Sur le dévasement des barrages-reservoirs en Algérie au moyen de la force motrice des eaux du barrage et de l'air comprimé (On silt removal from the storage reservoirs in Algeria by means of the motive force of water from the dam by compressed air). Assoc. Franç. pour l'Avance des Sci., Compt. Rend., vol. 10, pp. 243-251, 1881; [abstracts], Inst. Civ. Engin., Minutes of Proc., vol. 71, pp. 441-442, 1883; Van Nostrand's Engin. Mag., vol. 31, no. 188, p. 170, Aug. 1884. In French. Translation on file at the U. S. Soil Conservation Service, Washington, D. C.

Describes a means of removing sediment from reservoirs in Algeria. The method consists of blowing air into the sediment, thereby stirring it up and allowing it to run off with the water through pipes over the dam. Notes that the reservoir at Saint Denis du Sig with an original capacity of 122,000,000 cu. ft. silted up to the extent of 24,000,000 cu. ft. in 1879; silt deposits in the Habra Reservoir, constructed in 1871, reduced the original capacity of 105,000,000 cu. ft. to 70,000,000 cu. ft. by 1879.

2. Removal of silt from the back of reservoir dams in Algeria [abstract]. Van Nostrand's Engin. Mag., vol. 24, no. 146, p. 165, Feb. 1881.

Describes experiments at the Sig Reservoir in Algeria on the removal of silt from reservoirs by means of jets of compressed air. Details of the apparatus employed are described.

CAMERON, W. M.

1. The Gamka floods [letter to the editor]. Union So. Africa Dept. Agr. Jour., vol. 1, no. 2, p. 160, March 1911.

Presents briefly results of suspended silt determinations taken during a four-day flood of the Gamka River, Cape Province, Union of South Africa.

CAMP, THOMAS R. See also Dobbins, W. E., 1; Johnson, J. W., 8; Slade, J. J., 1.

1. The effect of turbulence in retarding settling. Iowa Univ. Studies in Engin. Bul. 27, pp. 307-317, illus., 1943.

A report which is a further development of studies entitled Effect of Turbulence on Sedimentation (Dobbins, W. E., 1). Describes work of Dobbins which includes the derivation of basic mathematical theory and experimental verification of certain cases. Treats of the approximate application of the results of Dobbins' studies to open-channel flow so as to

predict the effect of turbulence in retarding settling.

2. Sedimentation and the design of settling tanks. Amer. Soc. Civ. Engin., Trans., vol. 111, pp. 895-936, illus., 1947; also in Amer. Soc. Civ. Engin., Proc., vol. 71, no. 4, pt. 1, pp. 445-486, illus., Apr. 1945.

Collects into one work the known principles of sedimentation which are essential to design theory; presents the origin of the theory of design developed so that it can be used in practice. Practical examples are used to illustrate the use of the theory. Considers the settling characteristics of suspension in the design of settling tanks and comments on the theory of flocculation. Considers the settling velocities of individual particles, giving Newton's and Stokes' laws. Treats of the effects of turbulence on sedimentation, tractive force, and bed-load movement.

Discussion: NORVAL E. ANDERSON, pp. 937-938, questions most of Mr. Camp's conclusions on final settling tanks for the activated sludge process, his statements on density currents in shallow tanks, and the withdrawal of sludge at the effluent end of the tank. R. A. MULHOLLAND, pp. 938-939, notes various comments on the designing of sedimentation tanks.

CHARLES P. STEIN, pp. 939-944, treats of the importance of the mechanics of settling of particles in the design of settling tanks; comments further on the article by Mr. Camp and points out an error. Comments on consolidation tests to help clarify the problem of sludge compaction. LYN PERRY, pp. 944-946, comments on the rift between designers and operators and makes various comments on the article. E. SHERMAN CHASE, pp. 946-947, notes that the problem of design of practicable settling tanks depends for solution upon judgment, experience, common sense, and a moderate number of theoretical computations instead of elusive formulas. ROLF ELIASSEN, pp. 947-952, makes various pertinent comments on Mr. Camp's paper. Notes that the author did not go far enough in his development. Gives a table which shows an analysis of the design of selected settling tanks in the United States. Points out that the paper should be of value to designing engineers. THE AUTHOR, pp. 952-958, clarifies points brought up by discussers and presents additional information on the problem of designing settling tanks.

CAMPBELL, FRANK B.

1. Graphical representation of the mechanical analyses of soils. Amer. Soc. Civ. Engin., Trans., vol. 104, pp. 150-155, illus., 1939; also in Amer. Soc. Civ. Engin., Proc., vol. 63, no. 10, pp. 1861-1866, illus., Dec. 1937; [abstract], Iowa Univ., Studies in Engin., Bul. 19, p. 60, May 1939.

Presents an effort to correlate various existing methods of graphical representation of grain-size distribution in order to concentrate them into a standard method for graphical representation. Uses a semilogarithmic coordinate system with grain sizes plotted as abscissas on a logarithmic scale with the ordinates being cumulative percentages by weight. Suggests a division of soils into classes according to the sizes of the particles with class names. Notes that mechanical analysis is an indication of the history of the soil.

Discussion: DONALD M. BURMISTER, pp. 156-159, makes further comments on the graphical representation of size distribution. Treats of a description of grading curves as to type, based on statistical considerations. A. J. WEINIG, p. 159, makes a suggestion in the matter of diameter-grade designation. CARL H. KADIE, JR., pp. 159-161, comments on the need for standardization, shows a method of transfer of tabular data on soil separates to a mechanical analysis graph sheet for reproducing its curve. CARLTON S. PROCTOR, pp. 161-163, treats the confusion in soil classification as a confusion in terminology. T. T. KNAPPEN, pp. 163-164, considers the question of discarding the generic names of soil fractions. JACOB FELD, p. 164, deals with the separa-

tion of soil particles by means of square mesh screens. HOWARD F. PECKWORTH, pp. 164-165, suggests a change in names of grades if a proposed classification by the author is adopted as a standard. JOEL D. JUSTIN, pp. 165-166, doubts that the classification of soils proposed by the author has any practical advantage over the Kendorco classification and the modified Kendorco classification. L. B. OLMSTEAD, pp. 166-168, considers a modification of the proposed size classification, because engineers prefer more divisions in the coarse range and agronomists prefer more divisions in the fine range. Notes that a standard size classification of soil materials should be set up. T. A. MIDDLEBROOKS, pp. 168-169, questions the reason for changing from the classification of the U. S. Bureau of Chemistry and Soils. FRANK E. FAHLQUIST and WALDO I. KENERSON, pp. 169-174, note that the writers prefer the M.I.T. classification. Gives the modified Kendorco classification of soils, the soils being divided into 13 general classes. E. W. LANE, pp. 174-177, makes various comments on three principal points on mechanical analysis of soils brought out by Mr. Campbell. Gives a table showing the soil classifications of Udden, Atterberg, Wentworth, and Straub. K. J. SANGER, pp. 177-178, advises discarding divisions and percentages. To describe a soil, a chart and some moisture and plasticity data are necessary. F. KNAPP, p. 178, makes comments on the idea of designating a particular soil by grain size and grade. CHARLES H. LEE, pp. 178-182, comments on points brought out by the author; favors the classification by the U. S. Bureau of Chemistry as an engineering standard. THE AUTHOR, pp. 182-189, points out the need to bring order out of the many systems now in use for the recording and nomenclature of particle-size distribution of soils. States that the paper is not a new method, but a compromise between the two principal existing systems. Answers various questions brought out by the discussers and attempts to clarify various points further. Outlines the advantages and disadvantages of several systems of soil classification. Suggests that individuals, educational institutions, and agencies should all work together in drafting a standard form of mechanical analysis graph.

2. A rating-curve method for determining silt-discharge of streams. Amer. Geophys. Union, Trans., vol. 21, pt. 2, pp. 603-607, illus., July 1940.

Presents a method for the determination of a silt-rating curve which correlates silt-discharge and water-discharge for a given stream. Rating curve for Red River near Denison, Tex., is given in connection with investigations of the probable rate of silting in proposed Denison Reservoir. Discusses the efficiency of the silt-rating curve method for determining silt-discharge of Red River at Denison, and the applicability of the method to other streams. Theory involved in rating-curve method is briefly considered.

CAMPBELL, IAN. See Maxson, J. H., 1.

CAMPBELL, J. L.

1. The silting of reservoirs [letter to editor]. Engin. and Contract., vol. 35, no. 11, p. 321, Mar. 15, 1911.

Comments on D'Rohan's answer on Silting of Reservoirs (Engin. and Contract., Feb. 22, 1911). Discusses the impracticability of removal of mud from proposed Elephant Butte Reservoir which in 75 yrs. will replace the 2,500,000 acre-feet of water storage. Comments briefly on D'Rohan's proposed means of disilting the reservoir. Notes that water of Rio Grande carries ordinarily 3-5 percent of silt.

CAMPBELL, MARIUS R.

1. Geomorphic value of river gravels. Geol. Soc. Amer., Bul., vol. 40, no. 2, pp. 515-532, 1929; [summary] Pan-Amer. Geol., vol. 51, no. 2, pp. 143-144, Mar. 1929.

Considers river gravel as a means of determining the cycle of erosion in which it was de-

posited, and to determine recent crustal movements. Treats the conditions which lead to the formation of stream gravel deposits in various stages of the erosion cycle. Deals with supply of hard rock material, transportation and abrasion of this material, and deposition of the rounded material as pebbles, boulders, or cobbles.

CAMPBELL, WALTER M.

1. Water supply of Durban, South Africa [abstract]. Water Works, vol. 65, no. 2, pp. 88-89, Feb. 10, 1926.

Address before the African Section of the Institution of Municipal and County Engineers, Durban, July 1925, includes an account of the Shongweni works. Means of meeting the silting and other problems are discussed and details of works for the prevention of silt deposits in proposed Vernon Hooper Dam are described. The rate of silting in existing Camperdown Reservoir is given.

2. The water supply of Durban, Natal. Water and Water Engin., vol. 29, no. 346, pp. 349-351, illus., Sept. 20, 1927.

Describes the Shongweni water supply works, Port Natal, South Africa. Notes need for works since the capacity of the Camperdown Reservoir has been depleted 70 percent by silt deposits in 1926. Flood diversion scheme to avoid silt deposition in Vernon Hooper Dam is described.

3. Durban corporation waterwork's report on investigations for new source of water supply. 20 pp. Durban, Union of So. Africa, Mayor's Minute, 1930-31.

Discusses the further development of the Umlaas River concluding that further storage on the stream is not justifiable; notes that silting at Camperdown Dam during the past 28 yrs. amounts to 75 percent of the original full capacity. Results of investigations on the Umkomaas River are discussed noting conditions of erosion on Umkomaas watershed and conditions of silting which make utilization of the stream prohibitive. Compares the Umgeni and Tugela Rivers as potential sources of water supply considering the silting problem involved. Gives brief data on dissolved and suspended loads of the streams.

CAPLES, W. G.

1. Notes on regulation works, Tennessee River system. Prof. Mem. vol. 1, no. 3, pp. 283-290, July-Sept. 1909.

Comments on the efficiency of works for the regulation of the bed and banks of streams in the Tennessee River system.

CAREY, W. F. See also Stairmand, C. J., 1.

1. (and Stairmand, C. J.). Size analysis by photographic sedimentation. Inst. Chem. Engin. [London], Trans., vol. 16, pp. 57-62, illus., 1938.

Describes an apparatus for obtaining size analysis by photographic sedimentation; deals with the analysis of fine powders. Photographs are made of tracks of particles as they fall in stagnant liquid; the length of the track is a measure of the falling speed and allows the diameter of the equivalent sphere to be calculated.

CAREY, WALTER C.

1. The development of the asphalt mattress. Military Engin. vol. 27, no. 156, pp. 430-436, illus., Nov.-Dec. 1935.

A reinforced asphalt mattress was used by the Second New Orleans Engineer District for protection from erosion of the bank of the Mississippi River below Vicksburg in water of 7 ft. per sec. velocity, in depths as great as 160 ft. and with mattress widths up to 600 ft. at cost of \$14.00 per 100 sq. ft. and peak daily output of 130,000 sq. ft. Discusses mechanics of bank erosion and the need for revetments. History of development of asphalt mattress is given. Notes properties of ideal revetment, previous uses of asphalt for bank protection, material and construction details, use of asphalt for levee protection, and use of separate barges for mixing asphalt and preparing mattress.

CARHART, ARTHUR HAWTHORNE.

1. Colorado garners her beaver. Amer. Forests,

- vol. 46, no. 2, pp. 69-71, 89, 96, illus., Feb. 1940. Describes a plan instituted in Colorado for the use of beavers to create dams to impound water, retain silt, benefit irrigation, check flash floods, and raise the fish-carrying capacity of streams.
- CARLETON, E. A. See Slater, C. S., 1.
- CARMEN, J. ERNEST.
1. The Mississippi Valley between Savannah and Davenport. Ill. Geol. Survey, Bul. no. 13, 96 pp., illus., 1909.
Deals with the geology of the Mississippi Valley between Savannah, Ill. and Davenport, Iowa. Includes brief-discussion on the effects of rapid erosion on cultivated lands; gully development and stream and valley aggradation. Conditions of alluvial deposition and the character and extent of alluvial deposits in the valley are briefly considered.
- CARPENTER, L. G.
1. The loss of water from reservoirs by seepage and evaporation. Colo. Agr. Expt. Sta. Bul. 45, 32 pp., illus., May 1898; [abstract], Engin. Rec., vol. 37, no. 25, p. 534, May 21, 1898.
Presents results of a study on water losses by evaporation and seepage from reservoirs in Colorado. Includes brief discussion on the effect of the silting process upon conditions of seepage in reservoirs.
 2. On the losses from canals from filtration or seepage. Colo. Agr. Expt. Sta. Bul. 48, pp. 1-36, illus., July 1898.
Includes brief discussion on the use of sediment in canals as the most practicable method of reducing losses due to seepage.
- CARPENTER, L. V. See Slade, J. J., 2.
- CARREKER, JOHN R.
1. Soil loss on Georgia farms. Civ. Engin., vol. 12, no. 12, pp. 670-672, illus., Dec. 1942.
Discusses detailed measurement of rainfall as compared with the resulting soil loss and runoff on farm land in Georgia. Notes that greater use of lespedeza on crop lands would reduce runoff. Gives a table showing data on water and soil losses collected from plots with different cropping practices for 1941.
- CARROLL, DOROTHY.
1. Recording the results of heavy mineral analyses. Jour. Sedimentary Petrology, vol. 8, no. 1, pp. 3-9, illus., Apr. 1938.
Illustrates, by data from an examination of soils from western Australian gold fields, two diagrammatic methods of expressing the results of heavy mineral analyses. Describes technique used for mineralogical examination of soils and gives methods for presentation of these data.
 2. Grain counts with the petrographic microscope. Jour. Sedimentary Petrology, vol. 11, no. 1, pp. 44-45, Apr. 1941.
Describes a method used by the writer in making grain counts with the petrographic microscope.
- CARSON, W. W.
1. The Mississippi River problem. A new treatment. Engin. Assoc. of the South, Trans. vol. 5, pp. 13-21, illus., 1893.
Discusses the effectiveness of levees on the Mississippi for obtaining a navigable channel and for the protection of lands from overflow; and describes a plan utilizing the silt of the stream to hold caving banks.
- CARTER, ARCHIE NEWTON. See Liu, T. Y., 1.
- CARTER, O. M. See Craighill, W. P., 1.
- CARTER, OSCAR C. S.
1. Irrigation and the government irrigation project of Yuma. Franklin Inst., Jour. vol. 163, no. 3, pp. 217-242, illus., Mar. 1907.
Deals with irrigation practices in various parts of the world and describes the Yuma irrigation project in the United States. States that the Colorado River transports daily during high flood 1,500,000 tons of silt. Includes a description of the proposed Laguna weir noting features of design for the handling of silt.
- CASE, GERALD O.
1. The use of vegetation for reclaiming tidal lands. Engineering, vol. 196, pp. 264-265, Aug. 22, 1913.
Describes the function and use of vegetation in reclaiming tidal lands. Discusses the formation on tidal muddy foreshores of salt marshes, surfaces of which are gradually raised by sediment deposited by incoming tides, by streams bringing debris worn from the land, and by accumulation of dead vegetation and shell-bearing animals. Notes the agricultural value of reclaimed marshes.
- CASEY, HUGH J.
1. Über Geschiebepbewegung (Concerning bed-load movement). Preuss. Versuchsanst. für Wasserbau u. Schiffbau, Berlin, Mitt. vol. 19, 86 pp., illus., 1935. In German. Translation on file at the U. S. Soil Conservation Service, Washington, D. C.
A very comprehensive report in two parts on laboratory studies of movement of bed load. Pt. 1 contains the scope and aim of the work; basic discussion of the fundamentals of bed-load movement, including processes of movement, conditions which affect movement, and other relationships; and historical development and critique of equations for critical tractive forces and for bed load as found by various researchers. Pt. 2 includes the schedule of research; experimental procedure; and experimental results of laboratory studies carried on at the Prussian Research Laboratory for Hydraulic Structures and Ship Building at Berlin. Equations for a critical tractive force, bed load, and other quantities, based on experimental results, are given. A comprehensive bibliography of German-language publications is included in Appendix A. Appendixes B & C contain tabular data of experimental results.
 2. The use and construction of models in the design and construction of river control works. Natl. Res. Council Philippines, Bul. 24, pp. 198-227, Dec. 1939.
Deals with the use of small scale models for the investigation of hydraulic problems. Purpose of the hydraulic laboratory; types of experiments; transferability ratios; model similitude; distortion in models dealing with investigations on movement or erosion of stream bed (pp. 206-207); a typical hydraulic laboratory; construction of models; model experiments (movable bed model experiments, pp. 210-211); laboratory experiments in connection with the Passamaquoddy Tidal Power Project, Cape Cod Canal, etc.; model studies at U. S. Waterways Experiment Station, Vicksburg, Miss.
- CASKIE, JOHN A.
1. Siltation on the Modder River [extract]. Surveyor and Munic. and Co. Engin. vol. 68, no. 1755, p. 201, Sept. 4, 1925.
Extract from paper presented at the African District Meeting of the Institution of Municipal and County Engineers, Durban, July 20-23, 1925 dealing with the water reserves of Bloemfontein, Union of South Africa. Presents data on details of construction, rate of silting and means of desilting the Mazels Poort and Mockes Dam reservoirs on the Modder River.
- CASTLEMAN, R. A.
1. The resistance to the steady motion of small spheres in fluids. U. S. Natl. Advisory Com. Aeronaut., Tech. Note 231, 12 pp., tables, graphs, 1926.
Reports data obtained by various investigators on the resistance to the steady motion of small spheres in fluids, and presents it in logarithmic graphs. Gives a single continuous curve which represents an entire range of values.
- CAZAN, F. M. F.
1. Solids falling in a medium. I-II. Amer. Inst. Mining Engin., Trans., vol. 24, pp. 80-100; 339-351, Feb.-Oct. 1894.
I includes a discussion of the movement of solids in a medium, and a statement of a new natural law applicable to the determination of the velocity of a solid falling in water or any other medium. II presents a criticism of Rittinger's formula for settling velocity of a solid in water, and discusses differences between Rittinger's formula and that of the writer.
- CECIL, GEORGE H. See Hoyt, W. G., 1.
- CEFALU, FRANK D.
1. Report on current observations in the Gulf. 29 pp.

Burrwood, La., U. S. Engin. Dept. 1918.

Notes that currents carry suspended sediment a considerable distance seaward from jetty ends. Points out that contraction to 2400 ft. width and extension of jetties will cause the bed load to deposit farther seaward.

CHALLINOR, JOHN.

1. The curve of stream erosion. *Geol. Mag.*, vol. 67, no. 2, pp. 61-67, 1930.

Makes various fundamental assumptions on the subject of the curve of stream erosion. Shows the need for a re-examination of the whole question of river action and the importance of the evolution of the entire profile as a unit.

CHAMBERLAIN, E. T.

1. The prevention of abrasion of creek and river banks. *Ill. Soc. Engin. and Surveyors, Ann. Rpt.*, vol. 5, pp. 43-45, Jan. 1890; [abstract], *Engin. and Bldg. Rec.*, vol. 22, no. 14, p. 210, Sept. 6, 1890.

A paper on the abrasion of creek and river banks. Discusses causes of abrasion, noting action of waves, velocity of stream, and outflow of water through substrata of quicksand found under alluvial lands. Discusses the use of brush and stone revetment to prevent injury due to wave action, spur dikes to prevent injury due to excessive velocity, and the use of dikes or revetment to deposit coarse river sand against a bank affected by outflow of water through substrata.

CHAMBERLAIN, JOHN R.

1. Retards in stream control. *U. S. Bur. Pub. Roads, Pub. Roads*, vol. 7, no. 3, pp. 53-58, illus., May 1926.

Describes various methods employed in the control of streams in order that they maintain existing channels. Discusses characteristics of Missouri River and changes in its channel. Comparison of methods employed in stream control; use of current deflectors or retards, bank protection works, or both; development of methods of river control on the Missouri River; use of banks heads, longitudinal dikes, and abatis; use of retards anchored to shore and to stream bed; advantages of controlling long stretches of river.

2. Methods employed in stream control. *Engin. and Contract*, vol. 65, no. 6, pp. 264-268, illus., June 16, 1926.

Describes various methods employed in stream control of the Missouri River. Compares use of current deflectors or retarders, bank protection works, and a combination of both. Discusses the development of methods of river control. Describes use of bank heads, longitudinal dikes and abatis, bank revetment by wire and brush mattresses and current retards anchored to shore and to stream bed. Notes advantages of controlling long stretches of river.

CHAMBERS, ALFRED A. See Dole, R. B., 9.

CHAMBERS, T. B.

1. A Symposium - watershed management in relationship to water runoff and siltation - conservation farming reduces runoff and siltation. *Jour. Soil and Water Conserv.*, vol. 3, no. 1, pp. 32-34, Jan. 1948.

Considers the effect of conservation farming on runoff and siltation, and comments on Soil Conservation Service's useful conservation practices. Treats briefly production of silt by sheet erosion. Reduction of sediment losses is attributed to conservation farming.

CHANCE, H. M.

1. Thoughts concerning the Austin Dam failure [letter to editor]. *Engin. News*, vol. 43, no. 17, pp. 274-275, Apr. 26, 1900.

Notes the probable causes for the failure of the Austin Dam, Tex. Points out the possibility that pressure might have been exerted upon the dam by filled-in mud and sand resting against its upstream face, thus converting the dam into a retaining wall with increased pressure or thrust resulting from the mass of material pressing against it.

CHANDLER, ELBERT M. See Fortier, S., 2.

CHANDRA, A. L.

1. Silting up of the River Bidyadhari [letter to editor]. *Indian Engin.*, vol. 74, p. 302, Dec. 1, 1923.

Discusses proposed schemes for the removal of silt from the River Bidyadhari, India. Notes factors which are causing silt deposition in the river and briefly describes the effect of silting on the drainage of Calcutta.

2. Silting up of the River Bidyadhari [letter to editor]. *Indian Engin.*, vol. 74, p. 316, Dec. 8, 1923. Considers various schemes for the removal of silt from the River Bidyadhari, India.
3. Silting up of the River Bidyadhari [letter to editor]. *Indian Engin.*, vol. 74, p. 358, Dec. 29, 1923. Criticizes adopted scheme and presents an alternative scheme for the removal of silt deposits from the River Bidyadhari, India.

CHANG, C. C.

1. The silt problem and the water supply of the Saratsi project. *Assoc. Chinese and Amer. Engin.*, *Jour.*, vol. 16, no. 3, pp. 158-163, illus., May-June 1935. Deals with the silt problem and water supply of the Saratsi Irrigation Project, China. Discusses briefly anticipated and observed conditions of silting and scour in the Saratsi canal.

CHANG, J. See Kao, C. Y., 1.

CHANG, Y. L.

1. Laboratory investigation of flume traction and transportation. *Amer. Soc. Civ. Engin.*, *Trans.*, vol. 104, pp. 1246-1284, illus., 1939; also in *Amer. Soc. Civ. Engin.*, *Proc.*, vol. 63, no. 9, pp. 1701-1739, illus., Nov. 1937; [abstract], *Iowa Univ., Studies in Engin.*, *Bul.* 19, p. 60, May 1939.

Describes a laboratory investigation of problems of flume traction and transportation. Discusses and presents an equation for the tractive force required to cause initial movement for a series of uniform sands of various sizes. Laws of transportation by traction are considered, together with an equation to fit experimental data. The advance of riffles with relation to velocity of flow, and bed-load sorting phenomenon. Discusses laws relative to the transportation by suspension, the lifting force near the bottom, the vertical distribution of suspended sediment, an equation for total suspended load, the effect of silt transportation on stream energy, and the velocity of flow. Presents theoretical analyses and discussions of the work of other experimenters.

Discussion: HANS KRAMER, pp. 1285-1286, comments on Chang's investigation relative to the tractive force required to cause the initial movement of debris. Notes the difficulty of reconciling and correlating data observed and conclusions derived by different experimenters under widely divergent conditions. E. W. LANE, pp. 1286-1287, considers factors required to cause the initial movement of debris. Comments on Chang's conclusions relative to the resistance to motion of particles on horizontal and sloping beds and the effect of silt transportation on velocity of flow. JOE W. JOHNSON, pp. 1287-1293, comments on various formulas for the rate of transportation by flume traction. Notes investigations in 1937 to determine, for a certain set of published flume observations, whether a particular method of presenting data offer distinct advantages over other methods. Sources of errors in flume studies are discussed. J. E. CHRISTIANSEN, pp. 1293-1297, comments on formulas relative to the transportation of material in suspension. Discusses lifting force, distribution of suspended sediment, total suspended load, and effect of silt transportation on stream energetics. W. H. HUANG, pp. 1297-1298, develops an equation which may be used to calculate the tractive force in experimental flumes where the walls are of approximately the same roughness as the bed. LORENZ G. STRAUB, pp. 1298-1303, takes exception to various points in Chang's theoretical development and conclusions in connection with bed-load transportation by traction. HUNTER ROUSE, pp. 1303-1308, presents a general equation for tractive force in gradually-varied flow and in non-uniform flow. Briefly discusses a paper by A. Shields which shows that relative magnitudes of tractive force and the resistance to motion of uniform sediment grains could be expressed dimensionlessly. **THE AUTHOR**, pp. 1308-1313, comments upon the above discussions. Notes that investigation

of the influence of non-uniform flow is necessary in order to study debris transportation in natural water courses. Revises his conclusion that tractive force is due to an accelerating flow in a horizontal channel bottom. Explains the derivation of disputed formulas. Calls attention to recent publications on debris transportation.

CHAPIN, C. W. See Klorer, J., 1.

CHAPLIN, W. S.

1. Japanese methods of protecting the banks of rivers. *Van Nostrand's Engin. Mag.*, vol. 19, pp. 129-133, illus., Aug. 1878.

Describes Japanese river bank protection methods, particularly, the use of "stone-baskets."

CHAPLINE, W. R. See also Bennett, H. H., 1; Munns, E. N., 3.

1. Erosion on range land. *Amer. Soc. Agron., Jour.* vol. 21, no. 4, pp. 423-429, Apr. 1929.

Discusses erosion agencies and erosion losses on range lands and presents results of erosion control studies by the Forest Service at the Great Basin Experiment Station in Utah. Notes that the average effective life of 30 southwestern reservoirs used for livestock watering is less than 15 yrs. due to silt accumulations. The economic aspects of silting in Roosevelt Reservoir in Arizona are also noted. Maintains that among the numerous factors influencing erosion on range lands, vegetative cover is the main single controllable factor.

2. Erosion dares the West. *Amer. Forests*, vol. 37, no. 8, pp. 470-474, illus., Aug. 1931; also in *Sci. Amer.*, vol. 146, no. 1, pp. 34-36, Jan. 1932.

Describes conditions of erosion in western United States. Gives effect of erosion on floods, value of property, and deposition of silt. Notes that Zuni Reservoir in New Mexico in 22 yrs., filled to 70 percent of its capacity with erosion debris; Elephant Butte Dam in New Mexico filled 9 percent of its capacity in 9 yrs. Discusses the silt problem of the lower Colorado River, noting that silt formed the Imperial Valley creating much of its wealth but now threatens this wealth. Vast amounts of silt carried by water and deposited in river bed necessitates higher levees, clogs irrigation canals and seals soil with fine suspended material. Estimated average of 137,000 acre-ft. of silt carried past Hoover Dam site annually (Fortier and Blaney). At this rate the reservoir would be filled with erosion debris in 220 yrs. Means of maintaining capacities of reservoirs by increasing heights of dams or by dredging noted. Discusses factors influencing erosion and reducing protective covers of watersheds, noting the necessity for engineering works for erosion control. Discusses gully formation and sediment deposition in Utah during the floods of 1930. Erosion and stream-flow experiments on forest and range lands indicate value of vegetation in controlling erosion.

CHAPMAN, HERMAN H. See also Grover, N. C., 2; Richardson, F. H., 1; Sonderegger, A. L., 2; Woolley, R. R., 2.

1. Southern floods and their forestry lessons. *Amer. Forestry*, vol. 22, no. 272, pp. 476-479, illus., Aug. 1916.

Gives a description of the flood of July 15, 1916, in the mountains of western North Carolina. Rainfall of 10-15 in. during one night resulted in floods and great landslides or mud avalanches, carrying everything before them into streams. Debris was deposited 2-8 ft. deep on fertile lowlands. Retarding effect of forest cover on runoff was evident. Denudation of upper slopes by forest fires added to the destructiveness of the flood.

2. Forests and floods in China. *Amer. Forestry*, vol. 25, no. 320, pp. 835-843, illus., Feb. 1919. Discusses the effect of forests on floods in China and stresses the need for maintaining forests on mountain slopes. Includes brief discussion on the conditions of transportation and deposition of erosional debris by streams, and states that reforestation will diminish the amount of soil brought down from mountains and prevent the deterioration of rivers in China.

3. Influence of overgrazing on erosion and watersheds. *Civ. Engin.*, vol. 3, no. 2, pp. 74-78, illus., Feb. 1933.

Points out that too little control of grazing and of other agencies harmful to the natural cover is a cause of flood damage and the rapid increase in erosion in the intermountain region of the United States. Notes that engineering works alone cannot prevent erosion damage and restore the protection given by nature. Cites examples of destructive erosion and gullying. Suggests an intensive scientific study of the causes of erosion so as to determine control measures.

4. Effect of overgrazing upheld [letter to editor]. *Civ. Engin.*, vol. 3, no. 8, p. 472, illus., Aug. 1933.

Comment on discussions of the author's article *Influence of Overgrazing on Erosion and Watersheds* (Chapman, H. H., 3). Notes value of vegetative cover in reducing erosion and diminishing silt content of streams. Farmer's Union Reservoir on the headwaters of the Rio Grande, when drained, showed little sedimentation because the watershed was protected by vegetative cover. In contrast, the area east of Rangeley in western Colorado is eroding and dumping silt into the White and Colorado Rivers.

CHARLESTON, S. C., WATER DEPT.

1. Report, 1928. Charleston, S. C., Ybk., 1928, pp. 47-88, 1929.

Reports operations of the Commissioners of Public Works, Water Department, Charleston, S. C., 1928. Brief data are given on sanitary and mineral analyses of raw river water. Briefly describes the effects of the heavy rainfall of September 17-18 upon conditions of erosion in the City of Charleston; notes that some five or six acres of floating islands broke loose from their moorings upstream on the Goose Creek impounding reservoir choking 75 percent of the spillways at the dam.

CHASE, A. W.

1. On the Klamath River mines. *Amer. Jour. Sci.* (ser. 3), vol. 6, no. 31, pp. 56-59, July 1873.

Deals with the geology of the gravel deposits of the lower Klamath River and the theory of their formation.

CHASE, E. SHERMAN. See Camp, T. R., 2.

CHATLEY, HERBERT. See also Buckley, A. B., 1; Fawcett, P. N., 1; Todd, O. J., 10; Anonymous, 174.

1. Cohesion in river mud [letter to editor]. *Engineering*, vol. 107, p. 319, Mar. 7, 1919.

Explains the stability of mud channels in Egypt, India and China due to cohesion of mud particles on bed of stream.

2. Silt. *Inst. Civ. Engin., Proc.*, vol. 212, pt. 2, pp. 400-413, illus., 1921.

Deals with results of silt studies in the tidal section of the Whangpoo and lower Yangtze Rivers, China. Presents data on silt content; variations in tide and its effect upon silt content; settling velocity of sediment; origin and extent of sediment transportation; and bed-load movement. Concludes that erosion, suspension, and deposition of silt are influenced greatly by cohesion and colloid phenomena and that, in studying the equilibrium of silting river-beds, the complex processes of simultaneous erosion, accretion, lateral sliding, and vertical stream motion must be considered; and that owing to cohesion, bottom creep is less in silt river-beds than in fine sandy beds.

3. The physical properties of clay-mud. *Soc. Engin. (Inc.) Trans.* 1922, pp. 133-150, illus., 1922.

Considers characteristics of clay-mud including granulation, water content, chemical and mechanical properties, angle of friction, lateral pressure, and plasticity.

4. The properties of clay and silt. *Engin. Soc. China*, vol. 22, pp. 83-97, 1922/23.

Presents a digest and discussion of some recent scientific literature relative to the properties of clay and silt. Defines clay and silt. Expresses the various mechanical properties of clay and related materials in terms of gradation of particles and moisture contents. Weight, tensile strength, cohesion, gross

- internal friction, viscosity, elasticity, and plasticity are referred to the moisture content, the independent variable.
5. Silt equilibrium [abstract]. *Inst. Civ. Engin., Sessional Notices*, 1924-25, no. 3, pp. 78-80, Feb. 1925.
Discusses the stability of the regime in a silt-carrying stream. Notes conditions where Airy's criterion does not apply; discusses the causes of erosion and sustentation; describes the formation of fresh silt, and says there can be no saturation of a stream by silt short of the fluid-mud state. Characteristics of settled silt and methods of their determination are discussed.
6. The constitution of clay-mud. *Inst. Civ. Engin., Select. Engin. Papers*, no. 52, 15 pp., 1927.
Discusses the chemical and physical properties of clay-mud including capillarity, chemical constitution, size and shape of particles, source minerals, density and water content, chemical balance, plasticity, and stability of mud-clay. Conclusions of study by Dr. Terzaghi on the relations between porosity, compressibility, elasticity, and permeability of both sand and clay are given. Discusses the question of the deposition of clay-mud in a delta such as that of the Yangtze River with particular reference to the effect of salinity upon accelerated settlement.
7. Stability of dredged cuts in alluvium. *Dock and Harbour Authority*, vol. 7, no. 83, pp. 350-351, Sept. 1927.
Writer considers the extent to which dredging in alluvial bottoms is efficient, based on his experiences in the Whangpoo. Discusses, in this connection, the stability of regime of rivers in alluvium, conditions of scouring and silting in streams in alluvium, and factors affecting the equilibrium of an alluvial river bed. Factors to be considered in dredging operations are discussed.
8. Problems in the theory of river engineering. *Inst. Civ. Engin., Select. Engin. Papers*, no. 71, 23 pp., illus., 1929.
Deals with some problems involved in the theory of river engineering including discussions on the dimensional relations of river models, the occurrence of viscous flow in natural streams, the erosion of channel beds in alluvial soils, and the stability of a narrow cut dredged in wide channel.
9. The relation of the material to method of dredging in the Whangpoo River and Yangtze estuary. *Assoc. Chinese and Amer. Engin., Jour.*, vol. 11, no. 4, pp. 25-36, Apr. 1930.
Deals with the relationship of the characteristics of material to be dredged to the method of dredging as practiced in the Whangpoo River and the Yangtze estuary, China. Presents a brief discussion of the general operations involved in dredging and dumping material, types of dredgers and their efficiency, and estimated costs of operation. Examines the characteristics of material to be dredged including density, porosity, conditions of compaction, etc. Problems involved in specifications for dredgers are briefly discussed.
10. Curvature effects in alluvial channels. *Engineering*, vol. 131, no. 3396, pp. 196-197; no. 3397, pp. 260-261, illus., Feb. 13-20, 1931.
Discusses quantitatively the effects of curvature on changes in form and stability of a section of a channel with a movable bed.
11. The hydraulics of large rivers. *Civ. Engin. [London]*, vol. 33, no. 380, pp. 59-62, Feb. 1938.
Consists of a discussion of the modification of accepted rules and theories of hydraulic practice to unusually large rivers, and a brief discussion on the effects of deforestation and erosion upon stream and valley aggradation.
12. River flow problems. *Engineering*, vol. 146, no. 3783, pp. 61-62; no. 3786, pp. 165-166; no. 3788, pp. 223-224, July 15-Aug. 19, 1938.
River flow problems with particular reference to Chinese rivers. The first article discusses the regulation of rivers with training walls in tidal estuaries, and presents formulas for determining spacing of training walls. The second is concerned with the relation of tidal current in estuaries to conditions of bar formation and dredging works on tidal bars, and the relationship between bed-load movement and depth in open channels. The third discusses conditions of delta formation and growth and factors affecting them.
13. River-control problems. *Engineering*, vol. 146, no. 3801, pp. 579-580; no. 3803, p. 638; no. 3804, p. 681; no. 3806, pp. 740-742; no. 3807, pp. 754-755, Nov. 18-Dec. 30, 1938.
A series of articles. The first deals with soil erosion in relation to river control, and discusses sediment and presents data on the sediment load of the Yellow and Yangtze Rivers in China. The second discusses the relation between afforestation of the watershed and the rainfall, runoff, and erosion on river-flow-control problems. The third deals with the spacing of flood dikes; the fourth with a stable sectional form of alluvial rivers and the longitudinal profile of a river; and the fifth, with the stability of dredged cuts.
14. Vane-wheel eroder for Indian rivers [letter to editor]. *Engineering*, vol. 148, p. 282, Sept. 8, 1939.
Comments on Vane-Wheel Eroder for Indian Rivers (*Engineering*, vol. 148, p. 264-265, Sept. 1, 1939). Notes briefly the problems of operation and design to be considered in employing the jet-erosion process of maintaining small waterways.
15. Vane-wheel eroder for Indian rivers [letter to editor]. *Engineering*, vol. 148, no. 3850, p. 479, Oct. 27, 1939.
Letter to editor refers to a letter by A. Wills (*Engineering*, vol. 148, p. 421, Oct. 13, 1939). Comments upon the effectiveness and relative economy of the jet-erosion process of maintaining small waterways.
16. Terminal velocities. *Engineering*, vol. 149, no. 3860, pp. 6-7, Jan. 5, 1940.
Gives theory and formulas for determination of terminal velocity, or the maximum velocity developed by a falling body in a fluid medium. Includes data for terminal velocity in non-turbulent (Stokes) and turbulent flow, and the effect of shape of particles on terminal velocity. Discusses practical applications of terminal velocity.
17. The hydrology of the Yangtze River. *Inst. Civ. Engin., Jour.*, vol. 14, no. 6, pp. 227-234, illus., Apr. 1, 1940.
Includes brief discussion of the topography of the river and gives brief data on the source of silt, and the silt content of the stream.
18. Theory of meandering. *Engineering*, vol. 149, no. 3885, pp. 628-629, June 28, 1940.
Discusses the theory and presents mathematical equations concerned with the problem. Notes that river engineers working with alluvial stretches of rivers should consider such items as the thalweg, the air line, or length of shortest course a stream might take, the number of reversals of curvature in the thalweg, the bank widths, the change of bed material, and the minimum of radii of curvature in bends.

CHAWNER, W. D.

1. Alluvial fan flooding. *Geog. Rev.*, vol. 25, no. 2, pp. 255-263, illus., Apr. 1935.
Consists of a description of the conditions and effects of flood of 1934 in the Montrose-La Crescenta area, California. Discusses mudflow occurrence, transportation and deposition of silt by the Los Angeles River, character of flood deposits, estimates of total amount of rock debris eroded from watershed and deposited on streets and private property in Montrose, La Crescenta and on Pickens and Halls fans, and causes of flood and methods of protection against future floods.

CHEMIN, O.

1. On the amelioration of rivers with scourable bottoms and especially of the Loire...followed by a project for a trial of the oblique dams with suspended movable vanes (system Audouin). *U. S. Engin. School, Occas. Papers* 34, pp. 1-9, illus., 1908. Translation from the French of an extract

- from *Nouvelles Annales de la Construction*, April, 1904, and of the project dated Feb. 9, 1905, made at the U. S. Engineer School, 1908.
- Describes the design of M. Audouin for the permanent amelioration of rivers with erodible bottoms. The design consists essentially in the construction of oblique dams with suspended vanes joined to a convex shore of the stream. Conditions of scour and sedimentation induced by the spurs are described.
- CHERRY CREEK FLOOD COMMISSION.** See Denver Cherry Creek Flood Commission
- CHESTER, C. P.**
1. Protection of river banks with spur dikes [letter to editor]. *Engin. News-Rec.*, vol. 86, no. 24, p. 1047, illus., June 16, 1921.
Comments on the letter, Protection of River Banks with Spur Dikes (Ramirez, E., 1). Describes the construction of spur dikes in the Red River, to protect river banks.
- CHEYNE, G. C.** See Anonymous, 83; Leete, F. A., 1.
- CHI, CH'AO-TING.**
1. River problems in northern China. *Geog. Rev.*, vol. 25, no. 3, pp. 497-498, July 1935.
Reviews river, flood, and irrigation problems in northern China. Conditions of erosion and the transportation and deposition of sediment are briefly noted.
- CHIERA, ALBERT.**
1. [Review of] *Sistemazione dei Torrenti e dei Bacini Montani*, by C. Valentini. *Soil Conserv.* vol. 1, no. 3, p. 15, Oct. 1935.
Valentini discusses the influence of materials on the movement of water and proves that water charged with material moves more slowly than clear water, and that clear water possesses greater erosive power. Makes application of reasoning in the control of mountain torrents.
- CHINA, YANGTSE RIVER COMMISSION, TECHNICAL COMMITTEE.**
1. Second annual report. 38 pp., illus. Peking, 1924. (Pub. no. 2).
Presents various hydrological and topographical data gathered by the Yangtse River Commission during 1923. Data are given on the average amounts of silt in the Yangtse River at various observation points.
 2. Third annual report. 29 pp., illus. Peking, 1925. (Pub. no. 3).
Presents results of various hydrological observations on the Yangtse River taken during 1924. Results of silt determinations at the Hankow Station are given.
 3. Fourth annual report...for the year ending December 31, 1925. 30 pp., illus. Shanghai, 1925. (Pub. no. 4).
Presents results of various hydrological observations on the Yangtse River for the year 1925. Includes results of silt determinations made at the Hankow and other stations during 1925.
- CHITTENDEN, H. M.** See also Fox, S. W., 1.
1. Forests and reservoirs in their relation to stream flow, with particular reference to navigable rivers. *Amer. Soc. Civ. Engin., Trans.*, vol. 62, pp. 245-318, illus., 1909; also in *Amer. Soc. Civ. Engin., Proc.*, vol. 34, no. 7, pp. 924-997, illus., Sept. 1908.
Deals with the effect of forests and reservoirs on stream flow, as applied especially to navigable rivers. Discusses the source and extent of land surface reductions in the United States, and comments on the relative silt-bearing capacity of the Mississippi, Missouri, Ohio, Colorado, Rio Grande, Pecos, Arkansas, Columbia, and other rivers. Recounts the beneficial and harmful effects of silt-laden waters. Points out that individuals and communal organizations are interested in erosion control, in the influence of erosion on navigation, water power usage, and irrigation.
Discussion; THOMAS P. ROBERTS, pp. 321-327, considers relationship between forests and stream flow. Includes a paragraph describing conditions of silting and scouring in Ohio River noting that tributaries of this River, in the soft-rock regions in Kentucky and West Virginia, abounded with shifting sand bars, at the time this country was practically an unbroken forest.

- L. J. LE CONTE, pp. 329-332, notes the effect of land cultivation on runoff noting that observations on lakes and artificial reservoirs fail to show any noticeable increase in silting up due to cultivation of the soil. WILLIAM W. HARTS, pp. 347-361, states that the author agrees with Chittenden in not advocating reforestation and construction of impounding reservoirs for flood control and as aids to navigation. States reasons, noting among others that reservoirs soon fill with silt. Cites case of Tennessee River noting enormous scour on watershed which is carried down during high water. Claims that production of silt is due more to land cultivation than to cutting away of large trees. Contends that desilting of reservoirs results in formation of shoals and bars in river below. The accumulation of sediment at Austin Dam, Tex., reduced the capacity of the reservoir 38 percent in 3 yrs. after its completion. It is estimated that in 40 yrs. its capacity would be diminished 98 percent. States that rates of filling behind reservoirs would vary due to irregularity of soil wash in different parts of the country. M. O. LEIGHTON, pp. 394-442, comments on the relation between river improvement and sediment transportation on the Missouri River, and on the shoaling of streams due to erosion as exemplified by shoaling conditions on the Ohio River. Contends that Chittenden harbors a fundamentally erroneous conception of forest control of erosion. J. P. SNOW, pp. 450-454, notes the protective value of vegetation on river banks against erosion, the effect of sediment deposited in bars, other retarding disturbances on stream flow, and the effect of timber fringe removal from stream banks on bank erosion.
- CHOATE, SARAH P.** See Hatch, T., 1, 2.
- CHRISTIANSEN, J. E.** See also Chang, Y. L., 1; Griffith, W. M., 2.
1. Distribution of silt in open channels. 53 pp. Berkeley, 1934? Unpublished thesis - University of California.
A discussion of the theory of the suspension and distribution of silt in open channels. Comments on turbulence and the Austausch coefficient, settling velocity of silt in water, distribution of silt in open channels, and a comparison of observed and theoretical silt distribution.
 2. Distribution of silt in open channels. *Amer. Geophys. Union, Trans.*, vol. 16, pp. 478-485, illus., Apr. 1935.
Compares the author's observations on silt distribution in open channels with the theory advanced by Schmidt in *Der Massenaustausch in freier Luft und veranderte Erscheinungen*, 1925, and outlined by Morrough P. O'Brien (O'Brien, M. P., 1). Gives equations relative to turbulence in streams in connection with silt distribution in vertical sections. Discusses theories on the resistance to motion of solids in viscous fluids (settling velocity) and notes that settling velocity of silt in water depends upon chemical composition of water (Breazeale). Compares theory and available observed data on silt distribution for the Colorado River and Imperial Canal (Fortier and Blaney), and Nile River (Buckley). Notes need for additional field and hydraulic laboratory studies on stream velocity and silt concentrations in vertical sections, mechanical analysis of silt samples, and determination of energy gradient of streams.

CHUCK, H. S.

1. Results and deduction of surveys made at Shih Show district in preparation for the proposed dyke works. *Assoc. Chinese and Amer. Engin. Jour.*, vol. 6, no. 3, pp. 3-8, illus., Mar. 1925.
Describes results of surveys, 1923-24, to supply data for proposed reconstruction of dyke sections broken during the flood of 1918 in the Shih Show district on the Yangtze River. Discusses conditions of bank erosion and sedimentation prior to and after construction of the proposed works.

CHURCHILL, E. P., JR.

1. The oyster and the oyster industry of the Atlantic and Gulf coasts. *U. S. Bur. of Fisheries, Ann. Rpt.* Appendix 8, Doc. no. 890, 51 pp., illus., 1919.

CHURCHILL, E. P., JR. - Continued

In connection with the various factors of environment which affect oysters, the writer considers the effect of mud, silt, and suspended matter on oyster development.

2. (and Lewis, Sara I.). Food and feeding in fresh-water mussels. U. S. Bur. of Fisheries, Bul., vol. 39, pp. 439-471, illus., 1923-24.

Presents results of investigations by the Bureau of Fisheries at Fairport, Iowa, to determine whether mussels are selective in material ingestion. Includes a brief discussion of conditions of mussel feeding in silt-laden waters.

CHURCHILL, M. A. See also Gottschalk, L. C., 12.

1. Influence of field methods on silt determinations. 5 pp. Knoxville, Tenn., U. S. Tenn. Val. Authority, 1936.

A paper prepared for a field investigations conference at Asheville, N. C., June 26 and 27, 1936, outlining field practices to improve the results of silt determinations in order to obtain a true index of the total silt load. Discusses the effect of time of sampling, bottom sampling methods, silt peak lag due to reservoirs, and variation of velocity on result of suspended-load measurements.

2. Interpretation of tests on silt samplers [letter to editor]. Civ. Engin., vol. 11, no. 5, pp. 310-311, May 1941.

Comments upon results of tests with silt sampling instruments to evaluate their relative suitability under practical operating conditions.

3. Effect of density currents upon raw water quality. Amer. Water Works Assoc., Jour., vol. 39, no. 4, pp. 357-360, Apr. 1947.

Describes effects of density currents resulting from release of cold water from Norris Dam into the Clinch River and into the Watts Bar Reservoir. Density currents flow up the Emory River arm of Watts Bar Reservoir for a distance of 13 miles to Harriman, Tenn., located 1 mile below the head of the backwater, and affect the quality of the water taken from the reservoir by Harriman by carrying backflow of wastes from downstream sewers and paper plant.

4. The silt investigations program of the Tennessee Valley Authority. Fed. Inter-Agency Sedimentation Conf., Denver, 1947, Proc., pp. 52-54, 1948.

Describes the program of the Tennessee Valley Authority which consists mainly of silt investigations on the Tennessee River and its basin. Discussion: C. L. HALL, p. 54, considers our inability to cut down the amount of soil entering our streams more than 10 percent.

CHYN, SHIOU-DEAN.

1. An experimental study of the sand transporting capacity of flowing water on sandy bed and the effect of the composition of the sand. 33 pp., 1935. Unpublished thesis (M. S.) - Massachusetts Institute of Technology.

A study to determine to what extent and in which way the composition of sand will affect the total amount transported along the bed by flowing water. The main equipment used was a wooden flume. Discusses previous work on the theory of sand transportation. Analyzes the problem of sorting. Gives various results and conclusions obtained from the study.

CIRCUIT COURT. See U. S. Circuit Court.

CLAPP, EARLE H.

1. The major range problems and their solution; a résumé. 74th Cong., 2nd sess., S. Doc. 199, pp. 1-69, illus., 1936.

Considers the problem of range depletion and gives a general description of the western range. The amount of depletion is classified for the western area and causes of depletion are given. The erosion problem, silting of major streams by range ownerships, and flood damages are considered. Discusses the Taylor Grazing Act. Comments on public acquisition of land. Points out that the Elephant Butte Dam is filling at a rate of about 20,000 acre-feet annually. Various remedial actions are recommended.

2. Management and use of forest and range lands. In Upstream Engineering Conference, 1936. Head-

waters control and use, pp. 109-116, illus. Washington, Govt. Print. Off., 1937.

States that a cover of forest and range plants retards runoff and lessens soil erosion and flood danger, and that lack of a forest cover increases runoff, erosion, and floods. Discusses watershed protection and importance of land management.

Discussion: CLARENCE F. KORSTIAN, pp. 116-118, comments on the necessity of controlling waters at their source and the importance of a flood-control program. LEIGH J. YOUNG, pp. 118-119, comments on importance of a program of combining engineering works and reforestation at headwaters. Comments on erosion in a stream near Marion, N. C., and effects of watershed protection.

CLAPP, W. B.

1. (and Murphy, E. C., and Martin, W. F.). The flood of March, 1907, in the Sacramento and San Joaquin River basins, California. Amer. Soc. Civ. Engin., Trans., vol. 61, pp. 281-330, illus., 1908.

Describes causes and conditions of floods in the Sacramento and San Joaquin basins with particular reference to the flood of March 1907. Notes briefly that the deposition of mining debris in several tributaries of the Sacramento River caused channel filling and reduction of gradients resulting in the elevation of the flood plain.

2. The surface water supply of California, 1906. U. S. Geol. Survey, Water-Supply Paper 213, pp. 7-188, illus., 1908.

Describes the various river basins and creeks in California and presents data relative to gauge heights, stream flow, and runoff. Includes six paragraphs describing geologic growth of the Colorado River Delta, formation of the Salton Sea, flood conditions of 1905 resulting in the widening of the Alamo River and the development of the New River toward Salton Sea. The silt in the Colorado River is estimated at 53 sq. mile-ft. annually.

CLARK, H. WALTON. See Coker, R. E., 1; Wilson, C. B., 1, 2.

CLARK, O. H. See Eschmeyer, R. W., 1.

CLARK, WILLIAM C.

1. Ground water in Santa Clara Valley, California. U. S. Geol. Survey, Water-Supply Paper 519, 209 pp., illus., 1924.

Deals with the ground water supply in the Santa Clara Valley, California. Includes description of the alluvial fans and present stream channels of the valley. Notes conditions of aggradation in stream channels and the utility of the sedimentation process on San Francisquito and Alameda Creeks for the reclamation of salt marshes. Describes younger alluvium of the valley. Character of alluvium in relation to groundwater is discussed; composition of the alluvium of the Santa Clara Valley.

CLARKE, CLARENCE K. See Cory, H. T., 2.

CLARKE, FRANK WIGGLESWORTH.

1. The composition of the river and lake waters of the United States. U. S. Geol. Survey, Prof. Paper 135, 199 pp., tables, 1924.

Deals with chemical analyses of about 650 different waters in the United States, being concerned mainly with dissolved solids. Notes sources of various chemical elements in the waters. Gives suspended-load data in tons per day for various rivers in the Pacific Northwest.

2. The data of geochemistry. U. S. Geol. Survey, Bul. 770, Ed. 5, 841 pp., 1924. Earlier editions issued as Bulletins in the same series as follows: ed. 1, Bul. 330, 1908; ed. 2, Bul. 491, 1911; ed. 3, Bul. 616, 1916; ed. 4, Bul. 695, 1920.

Presents detailed data on geochemical action in nature. Includes data on the chemical analysis of waters in the St. Lawrence basin, the Atlantic slope, the Mississippi basin, southwestern rivers, rivers of California, the Columbia River basin, other northwestern rivers, rivers of Alaska, the Saskatchewan system, and rivers in South America, Europe, Asia, and Africa; organic matter in waters; contamination of river waters by human agencies; gains and losses in waters; and chemical denudation. In a discussion on the

decomposition of rocks, data are included on the chemical composition of river sand and silt.

CLARKE, HENRY T.

1. Channel protection on the Missouri River. Natl. Rivers and Harbors Cong., Proc. (1911), vol. 8, pp. 269-279, 1912.

Conditions of stream bank erosion on the Missouri River and measures for channel protection are described. Plan consists of straightening the river by cutting through sand bars and utilizing cables fastened to trees and brush from one sand bar to another to keep the channel in place. Method would induce accretions of silt which in turn would reinforce the protective works.

CLASSEN, ASHLEY GREEN.

1. Practical aspects of flood control and reclamation of overflowed lands. Tex. Reclam. Dept., Bul. 27, 80 pp., illus., Dec. 1935.

Discusses various practical aspects of flood control in connection with the development of flood control and prevention projects on smaller rivers and streams; need for flood control and reclamation of overflowed stream and valley bottoms is stressed. Discussion deals with proper design of floodways, channel improvement; and levee construction; soil conservation and erosion prevention measures.

CLAXTON, PHILIP. See also Griffith, W. M., 1.

1. Transportation of silt by flowing water. Punjab Engin. Cong., Minutes of Proc. (1925), vol. 13, pp. 47-67, illus., 1927.

Reviews the experiments of Chezy, Kennedy, and Gilbert relative to the transportation of silt by flowing water, bringing them into line with present thought, and making useful application of the investigations with especial reference to the design of groynes at the head of offtake canals.

2. The relativity of navigation and engineering science. Punjab Engin. Cong., Minutes of Proc. (1926), vol. 14, pp. 33-51, illus., 1927.

Deals with the interpretation of stream bed conditions by surface impressions and its value to the engineer in connection with the turning power of silt obtained from bank erosions and the transporting power when spread out in ridges over the bed.

3. Meanderings of alluvial rivers governed by a fixed law. Engin. News-Rec., vol. 99, no. 7, p. 268, illus., Aug. 18, 1927.

Considers the meandering of such alluvial rivers in India as the Sutlej, Chenab, and Indus, in which it is claimed silt eroded on one bank of a wide river will be deposited on the same bank further downstream, rather than on the opposite bank as is the case on narrower streams and in laboratory experiments. The deposition of the eroded silt causes shoals, bars and islands which tend to turn the river channel and cause river meandering.

4. Modification of Bell's Bund system simplifies river control. Engin. News-Rec., vol. 99, no. 18, pp. 720-722, illus., Nov. 3, 1927.

Describes a modification of Bell's Bund system as applied in India for protection of railroad embankments at river crossings by creating still water pockets and thus keeping swift waters away from the banks. Gives examples of modification of the system for protection of spur dikes in the Chenab River, to stop erosion in the Indus River noting applicability to storage reservoirs, and to train torrent discharge into the Sutlej River.

5. Inundation canal practice. Punjab Engin. Cong., Minutes of Proc., vol. 16, paper 119, pp. 57-72, illus., 1928.

Deals with the various aspects of inundation canal practice in the Punjab with especial reference to the Dera Ghazi Khan Division. Briefly considers the general behavior of rivers carrying large loads of silt. Methods of controlling rivers for inundation canals are described. The leading principles of the policy of combining river behavior and control for inundation canals are illustrated. Deals with the problems of gravitation and pumped supplies in the Dera Ghazi Khan.

6. The distribution of silt by canal irrigation. Indian Engin., vol. 84, pp. 262-265, illus., Nov. 10, 1928. Describes the various features of the Trunk Canal system, assisted by groynes, for the inland distribution of silt by inundation canals. Makes application of some of these features to perennial canal practice.

7. Stabilization methods used on the Indus recommended for the Mississippi. Engin. News-Rec., vol. 103, no. 16, pp. 619-621, illus., Oct. 17, 1929.

An article on the application of the principles of river control by the use of Bell's Bund system as practiced on the Indus River in India to conditions on the Mississippi River on the Plum Point Reach which had been discussed in a previous article (Williams, R., 1). Reasons for the change of the Mississippi River channel between 1904 and 1927 are suggested on the basis of bank erosion and subsequent deposition of the eroded silt on the same side of the river in the form of a shoal which turns the river into a new channel.

8. Channel regulation for the Mississippi. Engin. News-Rec., vol. 111, no. 20, pp. 584-585, Nov. 16, 1933.

Discusses cut-offs, branch closure, and bed load as pertaining to the new plan for Mississippi flood control as summarized in Engin. News-Rec., June 22, 1933 (Anonymous, 108). Treats of bank erosion, also, and its cause. Points out conclusions reached in regard to bed load movement: (1) transporting power of water is a function of depth, (2) bedload moves in small jumps and some jumps are not along the stream but across.

9. Influence of silt on river behavior. Inst. Civ. Engin., Jour., vol. 19, no. 3, pp. 183-190, Jan. 1943.

Discusses the effect of silt on the behavior of rivers. Gives detailed information on the mechanics of bed-load movement and the effects of bank erosion and the sediment derived from bank erosion on river regime.

CLEARY, EDWARD J.

1. Mopping up after the New England floods. Engin. News-Rec., vol. 116, pp. 566-571, illus., Apr. 16, 1936.

Discusses damage by floods to Lowell, Lawrence, Haverhill, and Springfield, Mass., Hartford, Conn., and Manchester, N. H. Describes methods of cleaning up after flood waters have receded. Notes cost of damage. The silt and mud, deposited on streets several feet deep were cleaned off with hose, plows, shovel gangs, etc. Notes clogged sewers and catch basins.

2. Pollution by soil erosion stressed by Potomac group. Engin. News-Rec., vol. 142, no. 18, pp. 11, 18, May 5, 1949.

Discusses a meeting of the Interstate Commission on the Potomac River Basin which was held to consider corrective reservoirs to alleviate the problem of pollution by soil erosion. Notes that Mr. Kemp, Director of Sanitary Engineering of the District of Columbia, revealed that last year the mud load of the Potomac at Washington was some 1,650,000 tons. Hugh H. Bennett, Chief of the U. S. Soil Conservation Service, made various comments on soil conservation programs. Notes a program of stream-pollution control inaugurated by General Motors.

CLEARY, JOHN B.

1. Silt problem in relation to intermittent stream bed reservoirs. Wyo. Engin. Soc., Proc., vol. 11, pp. 50-55, 1930.

Presents a compilation of available data on reservoir silting, noting in particular the gravity of the silt problem to intermittent stream-bed reservoirs. The Zuni Reservoir silted 94.89 percent of its total capacity in 22 yr.; old Lake Austin depleted 48 percent in 6.75 yr., 1893-1900, and new Lake Austin 95.39 percent in 13 yr.; silt deposits in Elephant Butte Reservoir amounted to 177,840 acre-feet from November 1916 to August 1925 or an average annual deposit of 20,470 acre-feet; lower Salt Creek Reservoir silted 76.3 percent of its original capacity in 3 yr. and 96.8 percent of its enlarged capacity in 5 yr.

Little silt was deposited in retarding reservoirs of the Miami Conservancy District since reservoirs were constructed to permit a constant out-flow. Median Lake, Tex., shows annual deposits of approximately 0.3 acre-feet of silt per sq. mile of drainage area. Three channel lakes constructed in 1895 on the clear fork of the Trinity River are practically free from silt since the bulk of the silt entering the lakes is carried over spillways. The silt burden of the Colorado River of Texas amounts to 1 percent; Moencopi Wash shows 85 percent silt and 15 percent turbid water after 2 days settlement. Presents data on silt accumulated per annum per sq. mile of drainage in old Lake Austin, new Lake Austin, McKinney Reservoir, Lake Penick, Lake Worth, Medina, Elephant Butte, Zuni, and Lower Salt Creek Reservoirs noting in particular variation of the silt carrying capacities from various drainage areas and the annual silt deposited from the same drainage area over various years. Writer's investigations on the proposed Salt Creek Reservoir employing comparable drainage area data are described. Estimated average silt deposit in the proposed reservoir is 264 acre-feet per year. From Jan. 1923 to Nov. 1926 reservoir capacity was reduced from 2,707 acre-feet to 643 acre-feet; capacity in Feb. 1929 was 200 acre-feet. Robinson reduced silt percentage in Zuni Reservoir from 3.6 acre-feet per sq. mile to 0.37 acre-feet per sq. mile per annum by construction of a series of check dams on tributaries of main stream. Notes methods of desilting reservoirs on Deep River, N. C., by sluicing; prolonging life of reservoirs in southwest by growth of tamarisk at heads of reservoirs; and plants to desilt Salt Creek Reservoir using roller bearing sluice gates.

CLEMMESHA, W. W.

1. Note on the silting up of the Bistupur Bhil at Berhampur [abstract]. All-India Sanit. Conf., Lucknow, Proc. 3, pp. 23, 1914.
Abstract of paper on deposition of silt from Bhagirathi River in Bistupur Bhil [silting basin?]. Estimates that it will take 15 yr. to silt up completely and make the area available for year-round cultivation.

CLEMONS, THOS. G.

1. Fertilizers. In U. S. Patent Office. Report of the Commissioner of Patents for the year 1859, pp. 136-178, illus. 36th Cong., 1st Sess., H. Ex. Doc. 11, 1860.
A paper on action, value, and source of various types of fertilizers, including several pages of discussion on the fertilizing value of silt. Cites the amount of sediment deposited annually by the Mississippi River and amount of sediment carried by the Rhine.

CLYDE, GEORGE D.

1. Control and use of small streams. In Upstream Engineering Conference, 1936. Headwater control and use, pp. 158-169, illus. Washington, Govt. Print. Off., 1937.
Describes various engineering structures for the control of small streams. Notes difficulties encountered in the control of streams which carry heavy loads of debris during floods; describes use of the barrier-control plan.
Discussion: E. R. JONES, pp. 169-175, comments upon lack of adequate sites for water-power development in the upper Mississippi Valley for which development has been necessitated because of the silting up of existing ponds. Notes that glacial lakes are becoming shallower because of deposition of silt on their beds and natural channel erosion that is lowering their outlets. Briefly describes preventative measures. ABEL WOLMAN, pp. 175-178, lists conclusions reached by the author and gives various comments.

COGEN, WILLIAM M.

1. Some suggestions for heavy mineral investigations of sediments. Jour. Sedimentary Petrology, vol. 5, no. 1, pp. 3-8, illus., Apr. 1935.
Analyzes methods used in describing quantitative relations between heavy minerals and

suggests a new method of representation. Directs attention to the variability in quantitative relations between heavy minerals due to changes in texture of sediments.

COGHLAN, R. R.

1. (and Lieb, Victor E.). Engineering investigation [abstract]. Reclam. Rec., vol. 7, no. 9, pp. 423-425, illus., Sept. 1916; other abstracts in Engin. and Contract., vol. 46, no. 11, pp. 249-250, Sept. 13, 1916; Engin. Rec., vol. 74, no. 12, p. 349, Sept. 16, 1916.
Describes briefly the methods employed and results of sampling to determine the weight, fineness, and partial and proximate analyses of moisture-free sediments in a cubic foot of deposited material as found on the bottom of Elephant Butte Reservoir. Discusses probable sequence of deposition of sediment in the reservoir and the rate of accumulation. Weight of dry sediment ranges from 53 to 90.89 lbs. per cu. ft. Gives results of chemical and mechanical analyses of sediment from different sections of the reservoir. Estimates the possible life of Elephant Butte Reservoir at approximately 233 yr.

COHEN, AARON.

1. Soil sampling and core boring equipment. Del. Water Supply News, no. 48, pp. 201-202, illus., July 15, 1940.
Describes details of sampling and core-boring apparatus used to collect samples of silt from West Branch Reservoir, New York, at the location of a proposed circular-cell cofferdam. Samples were taken at depths of 7, 12, and 17 ft. below the reservoir bottom.

COKER, R. E.

1. (and others). Natural history and propagation of fresh-water mussels. U. S. Bur. of Fisheries, Bul. vol. 37, pp. 79-181, illus., 1919-20.
A. F. Shira, H. W. Clark, and A. D. Howard, joint authors.
Deals with the natural history, growth, and development of fresh-water mussels in the United States. Includes brief discussion on the effect upon mussels of suspended and dissolved matter carried by stream waters. Gives data on contents of waters of certain productive mussel streams and of other non-productive streams.

COLDWELL, ALBERT E. See also Stevens, J. C., 6.

1. Transverse distribution of suspended sediment below river confluences. Amer. Geophys. Union, Trans., vol. 28, no. 5, pp. 747-751, illus., Oct. 1947.
Presents selected observations of suspended sediment concentration showing its transverse distribution for various discharge rates. Notes that stream water retains its identity, so far as suspended load is concerned, for some distance downstream from the confluences of Arkansas River with three tributaries near Tulsa and Muskogee, Oklahoma.
Discussion: BILLY T. MITCHELL and JAMES A. CONSTANT, (Amer. Geophys. Union, Trans., vol. 29, no. 3, pp. 415-417, June 1948), make various comments concerning Mr. Coldwell's paper. Notes observations made at Omaha, Neb. giving data on the size of distributions and concentrations of sediment samples. The color and concentration variation in streams is discussed. THE AUTHOR, Amer. Geophys. Union, Trans., vol. 29, no. 3, p. 417, June 1948, amplifies the original paper on some aspects of the transverse distribution of suspended sediment presented by Mr. Mitchell and Mr. Constant.
2. Effects of sediment on design and operation of dams and reservoirs. Fed. Inter-Agency Sedimentation Conf., Proc. 1947, pp. 142-157, illus., 1948.
Discusses effect of sediment upon total capacity in multiple-purpose reservoirs. Mentions problems given consideration in design and operation of the U. S. Corps of Engineers projects in the Tulsa District.
Discussion: LESTER C. WALKER, pp. 157-158, comments on depletion of storage capacity of the power pool by deposition of sediment in that pool instead of in the dead storage pool, and the rate and effects of degradation of the river

channel below the dam. OLIVER JOHNSON, CLARENCE PEDERSON, and H. O. WESTBY, pp. 158-160, give descriptions of the characteristics, sedimentation measurements, and estimates pertaining to several basins in the Pacific Northwest. GERARD H. MATTHES, p. 161, notes a low-cost plan to prolong the life of reservoirs built at high altitudes in the Rocky Mountains. THE AUTHOR, p. 161, states that the method described by Mr. Matthes would be too expensive for keeping large multiple-purpose reservoirs free of sediment unless the dredged material would be of economic value.

COLE, L. H. See Kindle, E. M., 12.

COLE, W. STORRS.

1. Modification of incised meanders by floods. Jour. Geol. vol. 45, no. 6, pp. 648-654, illus., Aug.-Sept. 1937.

Describes the significant changes in the structurally controlled meanders of Coy Glen near Ithaca, N. Y., which occurred during a flood of short duration in 1935. The most significant change was the truncation of projecting meander spurs. Estimates of the amount of material removed are given and major depositional changes are described.

COLEMAN.

1. Draining, irrigation and warping. From an agricultural tour. Farmers' Cabinet, vol. 9, no. 5, p. 148, Dec. 16, 1844.

Deals with general information relative to reclaiming land by warping and dredging sediment from stream bottoms in the vicinity of Yorkshire and Lincolnshire, England.

COLEMAN, J. F. See also West, C. R., 1.

1. Mississippi River—a national flood problem. Civ. Engin., vol. 1, no. 5, pp. 401-404, Feb. 1931. Considers the flood problem of the Mississippi and methods to alleviate it. Notes that bank erosion has caused the bends to lengthen themselves until the river from Cairo to the Coast is 75 miles longer than in 1882.

COLLIE, G. L.

1. Basin of the Po River [abstract]. Geol. Soc. Amer., Bul., vol. 15, pp. 566-568, Dec. 10, 1904.

The character of geologic and recent plain deposits, debris load of stream, and river conditions of aggradation and degradation are given, based on field work on the River Po plain in 1903.

COLLINGS, WILLIAM T., JR. See Rothery, S. L., 4.

COLLINGWOOD, C. B.

1. Waters and water analysis. Ariz. Agr. Expt. Sta., Bul. 4, 16 pp., Nov. 1891.

Gives information on methods for obtaining water samples and tables and descriptions of water analyses for different types of water in Arizona including that of the Colorado River. Description of irrigation water includes analysis of suspended matter from sample taken at Yuma and a short discussion of the fertilizing value of this sediment.

2. An examination of the soil of the mesa near Yuma, and of the waters of the Colorado. Ariz. Agr. Expt. Sta., Bul. 6, pp. 1-8, illus., Apr. 1892. Presents results of an investigation in regard to the agricultural possibilities of the soil of the mesa near Yuma, Ariz., and to the quality of irrigation waters and sediment of the Colorado River. Gives brief data on results of analyses of samples of Colorado River water, amount and quality of fine silt added to the soil, and value of the fertilizing material from Aug. 1892 to Feb. 1893, inclusive.

COLLINGWOOD, FRANCIS. See also Craighill, W. P., 1.

1. The control of non-navigable streams by the National Government. Amer. Soc. Civ. Engin., Trans. vol. 49, pp. 21-23, Dec. 1902. Consists of a discussion on the control of non-navigable streams by the national government. Describes after-effects of a disastrous flood at Elmira, N. Y., in the valley of the Chemung River, noting conditions of bank erosion and channel shoaling. Discusses deforestation as a cause of floods. Notes that silt observations on Tonto Creek, which is heavily grazed and bare of timber showed 0.00275 of 1 percent sediment while Salt River, below the junction with Tonto Creek, which is heavily timbered and carpeted with grass carried 0.00146 of 1 percent or only about half as much.

COLLINS, ARTHUR L. See Fairbank, L. C., Jr., 1.

COLLINS, HENRY H.

1. Soil or sediment? Nature Mag., vol. 31, no. 3, pp. 143-146, 190, illus., Mar. 1938.

General problems of siltation. Mentions briefly silting in Schoolfield Dam, Elephant Butte, Zuni Reservoir, Lake Calhoun, etc. Deals with methods of control of sedimentation, noting that the only way to overcome the menace of silt is complete erosion control on the entire watershed.

Discussion: ANONYMOUS, pp. 166, 187, states that Collins' proposal for complete erosion control of an entire watershed, to remedy the evil of siltation, is impractical and prohibitive because of the vastness of some watersheds such as that of the Colorado River. Proposes the utilization, especially for power purposes, of streams which are reasonably free from the danger of siltation.

COLLINS, ROBERT F.

1. (and Schalk, Marshall). Torrential flood erosion in the Connecticut Valley, March 1936. Amer. Jour. Sci. (Ser. 5), vol. 34, no. 202, pp. 293-307, illus., Oct. 1937.

Describes conditions of excessive erosion in a locality in the town of Hatfield on the west bank of the Connecticut River, above Northampton, Mass., during the flood of March 1936. Large concentrated flood currents eroded unconsolidated silts in a narrow section of the flood plain. Beneath the water surface, powerful vortices eddied toward the Connecticut River creating swirl pit excavations. Materials removed from pits were swept away by border top currents. Coalesced pits had a linear pattern in the direction of the current. The decreasing velocity of the flood caused the suspended sediment to settle in pits as a highly saturated thick silt blanket and with gradual recession of water, the silt blanket became compact.

COLLINS, W. D.

1. The quality of the surface waters of Illinois. U. S. Geol. Survey, Water Supply Paper 239, 94 pp., illus., 1910.

Presents results of observations on turbidity, dissolved- and suspended-load determinations of river and reservoir waters in the Michigan, middle Mississippi, Rock, Illinois, Wabash, Kaskaskia, and lower Ohio River basin in Illinois in 1906 and 1907. Methods of sample collection and analyses are described. Data are given for the reservoirs at Carter, Marion, Cypress, and Joppa, and for the Rock, Kankakee, Fox, Vermilion, Sangamon, Illinois, Kaskaskia, Muddy, Embarrass, Little Wabash, Cache, lower Ohio, and middle Mississippi Rivers.

2. (and Howard, C. S.). Quality of the surface water of New Jersey. U. S. Geol. Survey, Water-Supply Paper 596-E, pp. 89-119, illus., 1927.

Presents results of dissolved- and solids-load determinations of surface waters of New Jersey. Methods of analysis and results of analyses of typical samples of surface waters of New Jersey are given.

3. (and Howard, C. S.). Quality of water of Colorado River in 1925-1926. U. S. Geol. Survey Water-Supply Paper 596-B, pp. 33-43, illus., 1927.

Analyses are given representing composites of daily samples collected at the U. S. Geological Survey stations at Grand Canyon and Topock, Ariz. Describes method of analyses and gives results in tabular form of dissolved and suspended matter found in the water.

4. (and Howard, C. S.) Dissolved matter in Colorado River [abstract]. Water Works Engin., vol. 81, no. 8, p. 488, Apr. 1928.

Indicates that the dissolved solids are 250-1500 p.p.m. Suspended matter of 225,000,000 tons in 1925-26 and 443,000,000 tons in 1926-27 is reported. The volume per ton is not estimated.

5. (and Howard, C. S.). Dissolved and suspended mineral matter in Colorado River. Indus. and Engin. Chem., vol. 20, no. 7, pp. 746-748, July 1928.

Deals with the problem of dissolved and suspended mineral matter in the Colorado River.

Dissolved solids range from about 250 to about 1500 p.p.m. Gives data on suspended and dissolved matter carried by the Colorado River.

6. (and others). Chemical character of surface waters of Virginia. Va. State Comm. on Conserv. and Develpmt., Div. of Water Resources and Power, Bul. 3, 148 pp., illus., 1932.

E. W. Lohr, K. T. Williams, H. S. Haller, and O. C. Kenworthy, joint authors.

A preliminary report by W. D. Collins, K. T. Williams, and E. W. Lohr was issued in 1930 as Bul. no. 2 in the same series.

Results of dissolved and suspended-load determinations made in 1930-31 for streams in the Potomac, Rappahannock, York, James, Chowan, Roanoke, New, Big Sandy, and Tennessee River basins in Virginia are presented.

7. Dissolved mineral matter in surface-waters. Amer. Geophys. Union, Trans., vol. 17, pp. 452-453, 1936.

Reports dissolved solids determinations obtained in studies made by the U. S. Geological Survey for the Colorado River and its tributaries. Weighted averages of dissolved solids in 10-day composites from Colorado River at Grand Canyon for different years (1915-25) range from 491 p.p.m., for the year ending September 1928 to 960 p.p.m. for the year ending Sept. 30, 1934. Notes that comparative analyses of dissolved solids for the Colorado River at various points prior to the closure of Boulder Dam indicated the uniformity of content; after closure in February 1935, the water at Willow Beach showed the effects of mixing in Lake Meade. Discusses probable content of dissolved solids in water drawn from Lake Meade.

8. Determinations of loads of suspended matter in small streams. U. S. Geol. Survey, Water Resources Br., Quality of Water Div., Memo., May 10, 1939, 7 pp., illus.

Points out errors which might result if attempts were made to compute suspended-matter loads of small streams without adequate discharge and sampling records. Shows records and computations for rises on Coon Creek at Coon Valley, Wis.

9. (and Howard, C. S., and Love, S. K.). Quality of surface waters of the United States 1941. U. S. Geol. Survey, Water-Supply Paper 942, 74 pp., tables, 1943.

Tables show the analyses of water obtained from various streams in the United States for the period Oct. 1, 1940 to Sept. 30, 1941. Gives also the percentage of suspended matter for various streams in the United States. Some of the stations reporting sediment data are: Chattahoochee River at Columbus, Ga., Chattahoochee River at Columbia, Ala., the Canadian River near Sanchez, N. Mex., Rio Grande at San Acacia, N. Mex., Colorado River at Bright Angel Creek, near Grand Canyon, Ariz., San Juan River at Shiprock, N. Mex., San Juan River near Bluff, Utah, and the Animas River at Farmington, N. Mex.

10. (and Love, S. K.). Quality of surface waters of the United States, 1942. U. S. Geol. Survey, Water-Supply Paper 950, 68 pp., 1944.

Includes tables which give data on the quality of surface waters of the various streams in the United States. The samples were collected from Oct. 1, 1941 to Sept. 30, 1942. Gives records of daily, monthly, and annual loads of suspended sediment stations on streams in the Colorado River basin. Includes also data on the suspended load and the mechanical analyses of sediment from the Colorado River near Cisco, Utah, the Colorado River at Bright Angel Creek near Grand Canyon, Ariz., Green River at Green River, Utah, and San Juan River near Bluff, Utah.

COLUMBUS, OHIO, DEPT. OF PUBLIC SERVICE.

1. Annual report of the Division of Water for the year 1935. City Bul., Sup., 1935, pp. 70-79, 1935.
A report of operations of the Division of Water, Department of Public Service, Columbus, Ohio, for the year 1935. Tabulates data on the general characteristics of the Griggs and O'Shaughnessy Reservoirs. Results of investigations as

to the extent of silting in each reservoir are given. Survey of O'Shaughnessy Reservoir made in 1934, nine years after its completion indicated that total capacity of reservoir decreased from 5,432 M.G. to 5,100 M.G. due to silting. Total capacity of Griggs Reservoir decreased from 1,720 M.G. to 1,278 M.G. since its completion in 1905 to date of survey in 1935.

COLYER, C. A.

1. Note on silt and velocity experiments. Punjab Public Works Dept., Irrig. Branch, Papers 28, pp. 63-66, illus., Feb. 8, 1926.

Presents results of silting and velocity experiments (1923) for the Ravi River and Balloki Division, Lower Bari Doab Canal. Sampling apparatus is described.

COMBER, NORMAN M.

1. The mechanism of flocculation in soils. Faraday Soc., Trans., vol. 17, no. 50, pt. 2, pp. 349-353, Feb. 1922.

Presents some observations concerned with the flocculation process as brought about by electrolytes in general and lime in particular. Treats the flocculation of soils and the iso-electric point theory.

2. The flocculation of soils. Jour. Agr. Sci., vol. 10, pt. 4, pp. 425-436, Oct. 1924.

Points out that silt suspended in water is most easily flocculated by calcium salts when the suspension is neutral. Notes that alkalinity decreases the flocculating effect of the calcium ion on silt suspensions. Soil clay is precipitated from alkaline suspensions more readily than from neutral suspensions.

COMBS, THEODORE C.

1. Cucamonga Creek water conservation project. West. Construct. News, vol. 7, no. 23, pp. 691-693, illus., Dec. 10, 1932.

Consists of a description of this project, now under construction, which is provided for in a joint program of the State of California and San Bernardino County. Items provided for include heavy debris disposal at the mouth of Cucamonga Canyon by means of check dams and disposal of fine material carried in flood waters by passing flood waters through several low velocity desilting canals.

COMSTOCK, C. B. See Corthell, E. L., 1.

COMSTOCK, E. F.

1. Protecting valuable river lands in California. Engin. News., vol. 73, no. 17, p. 827, illus., Apr. 29, 1915.

Consists of a description of Dean river-current deflector used on the Russian River, Sonoma County, Calif., which causes deposition of suspended matter and retards bank erosion.

CONKLIN, HARRIS.

1. Ventura County investigations. Calif. Dept. Pub. Works, Div. Water Resources, Bul. 46, 244 pp., illus., 1934.

An investigation of the water supply of a portion of Ventura County, Calif. Considers briefly the silt problem; states that no way has been found for its disposal from surface reservoirs.

CONKLING, HAROLD.

1. San Gabriel investigation. Calif. Dept. Pub. Works, Div. Water Rights, Bul. 7, 155 pp., illus., 1929.

Presents results of a hydrological study of the San Gabriel basin, Calif. Includes brief discussion on the porosity of the material over which the water flows in the San Gabriel Valley, and the effect of conditions of stream erosion and deposition upon rates of percolation.

CONNAUGHTON, CHARLES A. See Bailey, R. W., 1; Watts, L. F., 1.

CONNAUGHTON, MARK P. See also Rittenhouse, G., 15.

1. Preliminary notes on reservoir studies in the Great Plains States. Soil Conserv., vol. 3, no. 8, pp. 232-233, illus., Feb. 1938.

An article giving a brief resumé of pertinent regional characteristics in the Northern Great Plains States where the Section of Sedimentation Studies of the Division of Research has completed 10 reservoir sedimentation surveys in Montana, Nebraska and Kansas. A partial summary of data collected is given. Discusses conditions governing rate of reservoir silting noting factors affecting runoff and erosion, upstream deposition, and bypassing of erosional debris through reservoir.

2. Advance report on the sedimentation survey of Hayes Lake, Hayes, South Dakota. U. S. Soil Conserv. Serv., SCS-SS-20, 28 pp., illus., July 1938.

During June 1937 the U. S. Soil Conservation Service conducted a sedimentation survey of Hayes Lake, a recreational reservoir located on Frozenman Creek at Hayes, S. Dak., and of two of the ten stock ponds located in the watershed above Hayes Lake. Since storage began in Hayes Lake in March 1933, 49 acre-feet of sediment accumulated which reduced the original storage capacity of 629 acre-feet to 580 acre-feet. This amount is equal to 7.79 percent of the original capacity and an average reduction of 1.86 percent per year for the 4.2 yr. the reservoir has been in operation. Of the total of 49 acre-feet of sediment in the reservoir, 16 acre-feet was deposited during a single flood following intense rainfall of June 1937. The average weight of reservoir silt per cubic foot was determined to be 41.7 lbs. for the old silt and 32.7 lbs. for recently deposited silt. The original capacity of Elkins No. 1 stock pond was reduced from 18.61 acre-feet to 15.78 acre-feet or 15.21 percent and that of Elkins No. 2 stock pond from 4.34 acre-feet to 3.18 acre-feet or 26.73 percent in 28 and 26 yr., respectively. As a result of the flood of June 1937, 0.63 acre-foot of sediment was deposited in Elkins No. 1 and 0.66 acre-foot in Elkins No. 2. Of the watershed area of 40 sq. miles, approximately 85 percent is open range used for grazing purposes. Detailed information is included on character, distribution, origin and volume of sediment in the reservoir, as well as engineering data pertaining to the dam and reservoir.

3. (and Hough, Jack L.). Advance report on the sedimentation survey of Burlington Reservoir, Burlington, North Carolina. U. S. Soil Conserv. Serv., SCS-SS-28, 25 pp., illus., Dec. 1938.

A sedimentation survey conducted by the U. S. Soil Conservation Service during the period Apr. 16 to May 21, 1938, at Burlington Reservoir, a municipal and domestic water supply and recreational development, located on Stony Creek, 3 miles northeast of Burlington, N. C., revealed that the reservoir had lost 10.95 percent of its original capacity of 1,488 acre-feet since its completion in June 1928; average annual depletion of 1.10 percent. Total sediment accumulation in reservoir amounted to 163 acre-feet after 10 yr. of operation; an average annual deposit of 16.3 acre-feet. Severe sheet erosion and occasional to frequent gullies characterize erosion conditions on the watershed. Of the watershed area of 105 sq. miles, 35 percent is cultivated, 50 percent is woodland, and 15 percent is abandoned land and pasture. Data on estimated soil removal from watershed and on the volume of sediment in the reservoir indicate the colluvial and alluvial deposition in the drainage area and the bypassing of sediment through the reservoir. Urges widespread application of erosion control measures to protect reservoir from continued excessive silting. Includes detailed data pertaining to the engineering features of dam and reservoir, character of watershed, and character, distribution, and origin of reservoir sediment.

4. (and Barnes, Leland H.). Advance report on the sedimentation survey of Franklinton Reservoir, Franklinton, North Carolina. U. S. Soil Conserv. Serv., SCS-SS-30, 15 pp., illus., Jan. 1939.

A sedimentation survey conducted by the U. S. Soil Conservation Service during the period May 16-18, 1938, at Franklinton Reservoir, a small basin-type water-supply reservoir, located on Sallie Kearney Creek, 1 mile west of Franklinton, N. C., revealed that the 34.7 acre-foot reservoir had lost due to silting 21.33 percent of its original capacity since its completion in January 1925, average annual depletion of 1.60 percent. Total sediment deposits in the reservoir after 13.3 yr. of operation amounted to 7.6 acre-feet; average annual

accumulation of 0.57 acre-feet. About 60 percent of the 1.13 sq. miles of drainage area is cultivated, and the remaining 40 percent is largely forested. Sediment in reservoir originates in cultivated upland areas and is chiefly the result of sheet erosion. Data on the removal of soil due to erosion and data on the volume of sediment in the reservoir indicates colluvial and alluvial deposition in the drainage area and the bypassing of sediment through the reservoir. Urges widespread application of soil conserving measures in cultivated upland areas of the watershed in order to reduce rate of reservoir storage depletion. Includes detailed data pertaining to the engineering features of the dam and reservoir, character of watershed, and character, distribution, and origin of reservoir sediment.

5. Turbidity vs. sediment concentration. U. S. Soil Conserv. Serv., Sedimentation Div., Tech. Let. Sed-1, 6 pp., Feb. 20, 1939.

Defines turbidity, sediment concentration, and coefficient of fineness. Gives a table showing coefficients of fineness of Missouri River sediment over a 26-month period. Shows the variation in the relationship of turbidity and concentration. Notes the uses of turbidity data, pointing out that computations of tonnage of silt based on turbidity are subject to error, but turbidity data may be useful in obtaining rough approximations based on certain watershed studies. Lists information to be obtained when attempting to use turbidity data.

6. (and Hough, Jack L.). Advance report on the sedimentation survey of Lake Lee, Monroe, North Carolina. U. S. Soil Conserv. Serv., SCS-SS-34, 23 pp., illus., Oct. 1939.

A sedimentation survey, conducted by the U. S. Soil Conservation Service during the period May 23 to June 14, 1938, at Lake Lee, located on Richardson Creek, 2 miles east of Monroe, N. C., and which serves as the municipal water supply for that city, revealed that the 821 acre-foot channel-type reservoir had lost 20.58 percent of its original capacity due to silting since its completion in April 1927; an average annual depletion in capacity of 1.85 percent. Total accumulations in reservoir during the 11.1 yr. of operation amounted to 169 acre-feet; an average annual accumulation of 15.2 acre-feet. Of the 50.5 sq. miles of drainage area 45 percent is cropland, 9 percent is open pasture, and 46 percent is forest. Area is undergoing slight to moderate sheet erosion and some minor gullying. Reservoir sediment is fine silt and clay with average median diameters of 3-8 microns and average dry weight of 62 lbs. per cu. ft. Correlates distribution of sediment in reservoir with silt underflow, an observation made during survey. Marked differences in rate of sedimentation on two arms of Lake Lee are correlated with drainage area and reservoir characteristics. Total life expectancy of reservoir is only 54 yr. This emphasizes need for widespread erosion control and soil conservation measures on watershed and the bypassing, through the "blow off" valve in the base of the dam, of sediment-laden underflow. Report includes detailed data on the engineering features of the dam and reservoir, character of drainage basin, method of sedimentation survey, character, distribution, and origin of reservoir deposits, silt underflow observations, and desilting of reservoir.

7. (and Hough, Jack L.). Advance report on the sedimentation survey of Lancaster Reservoir, Lancaster, South Carolina. U. S. Soil Conserv. Serv., SCS-SS-36, 18 pp., illus., Sept. 1940.

A sedimentation survey made June 15-30, 1938 by the U. S. Soil Conservation Service on Lancaster Reservoir, a municipal water supply reservoir located on Turkey Water Creek, 1/2 mile above its junction with Bear Creek, near Lancaster, S. C. Survey indicated that the 242 acre-foot reservoir, constructed in 1925, had lost, due to silt accumulations, 21.49 percent of its original capacity in 13.4 yr.; an

CONNAUGHTON, MARK P. - Continued

average annual depletion of 1.60 percent. Drainage area has been subjected to an unusually high degree of intensive cultivation, and moderate to severe sheet erosion and occasional gullyng has occurred over the greater part of this area. Includes information on the engineering features of the dam and reservoir and character of the drainage basin, as well as character, distribution, and origin of sediment in the reservoir. Recommends erosion-control measures to reduce the rate of sediment accumulation in the reservoir.

CONNECTICUT STATE WATER COMMISSION.

1. Fifth biennial report, 1932-34. 72 pp., illus. Hartford, 1934.

Deals with the program and work of the Connecticut State Water Commission for 1932-34. Includes data on suspended load from the following stations: Quinebaug River at Jewett City, Shetucket River at South Windham, Connecticut River at Thompsonville, Naugatuck River at Beacon Falls, Housatonic River at Sandy Hook, Quinebaug River at Putnam, Hockanum River at Burnside, Farmington River at Tariffville, Housatonic River at Lime Rock, and Shepaug River at Roxbury.

2. Sixth biennial report, 1934-36. 102 pp., illus. Hartford, 1936.

Describes the work and presents results of observations of the Connecticut State Water Commission. Includes brief tabular data (pp. 23-27) on turbidity and suspended and dissolved matter (January to December 1936) in the Quinebaug River at Putnam and Jewett City, Natchaug River at Williamantic, Shetucket River at South Windham, Hockanum River at Burnside, Connecticut River at Enfield Dam, Quinipiac River at Wallingford, Farmington River at Tariffville, Naugatuck River at Thomaston and Beacon Falls, Shepaug River at Roxbury, Housatonic River at Lime Rock and Sandy Hook, and Saugatuck River at Westport.

3. Eighth biennial report, for the years 1938-1940. 84 pp., illus. Hartford, 1940.

Describes work of and presents results of observations by the Connecticut State Water Commission for the year 1939. Includes brief tabular data on turbidity, suspended and dissolved matter in the Connecticut River at Enfield, Quinebaug River at Jewett City, Shetucket River at South Windham, and Naugatuck River at Sandy Hook. Dredging operations on the Salmon River and conditions of silt and debris deposits in the Hockanum and Norton Rivers are briefly described.

CONNER, A. P.

1. Getting clear water from a muddy river [letter to editor]. *Power*, vol. 38, no. 18, pp. 611-612, illus., Oct. 28, 1913.

Report on the phenomenon of clear water being found and utilized in a hole 40 ft. deep in the bottom of a muddy river 50 ft. deep (total depth of hole 90 ft.) found 50 ft. from shore. Water from hole had year-round temperature of approximately 50° F. Above the hole there was a slow steady current of muddy water. Clear water piped and pumped to shore and used to supply brewery. Hole caused by a peculiar rock formation in river bottom and acts as natural desilting basin. Author believes condition can be duplicated by driving tank in bottom of river bed. Explains reason for temperature uniformity.

CONSTANT, JAMES A. See Coldwell, A. E., 1.

CONTI, LUCIANO.

1. Trasporta solido die corsi d'acqua, richiamo di alcune nozioni generali (Transportation of solids in open channels, review of some general concepts). *Internatl. Geod. and Geophys. Union, Comn. Potamology*, Rpt. 12, Question 3, 21 pp., 1939. In Italian. Translation on file at the Research Center Library, Waterways Experiment Station, Vicksburg, Miss.

Deals with the determination of formulas concerning the problem of the transportation of solids in open channels.

CONWAY, W. M.

1. Exploration in the Mustagh Mountains. *Geog. Jour.*, vol. 2, no. 4, pp. 289-299, Oct. 1893.

Treats an exploration in the Mustagh Mountains, India. Describes mud avalanches which occur in the Gilgit Valley. Notes that mud avalanches appear to be annually discharged in the desert ranges of Asia.

COOK, A. C. See Bloodgood, D. W., 1, 8.

COOK, GEORGE H.

1. Third annual report on the geological survey of the State of New Jersey for the year 1866. *N. J. Geol. Surv. Ann. Rpt.* (1866) 3, 27 pp., illus., 1867.

In addition to presenting results of surveys conducted during the year 1866, includes brief discussion on the reclamation of tidewater meadows of Salem and Cumberland Counties by allowing muddy stream waters to enter and deposit sediment upon lands.

COOK, HOWARD L.

1. Outline of the energetics of stream-transportation of solids. *Amer. Geophys. Union, Trans.*, vol. 16, pt. 2, pp. 456-463, Aug. 1935.

Notes the problem of stream-transportation of solids through consideration of energy relations. Analysis shows real nature of various difficult problems involved with possible methods of solution, which will afford a rational basis for systematic interpretation of experimental results. Discusses energy of flowing water, rate and total amount of expenditure of energy in transporting debris, nature and use of energy expended (energy-demands), and forces exerted. Gives applications of ideas outlined to interpretation of experimental data noting problems of (a) stream of clear water in uniform flow moving bed-material without formation of bed or surface waves, (b) addition of suspended load to (a), and (c) bed-load movement for uniform flow, uniform bed-load flow, no suspended load, and surface and bed waves existing. General applications noted.

2. Flood abatement by headwater measures. *Civ. Engin.*, vol. 15, no. 3, pp. 127-130, illus., Mar. 1945.

Shows that land treatment is effective in reducing flood damage on headwater streams; the measures have little effect on major floods of main rivers and supplemental downstream control works. Discusses damages caused by sediment.

COOKE, MORRIS L. See also Silcox, F. A., 2.

1. Dams are not enough. *Amer. Forests*, vol. 42, no. 6, pp. 251-253, 286, illus., June 1936.

Deals with flood and erosion conditions in the United States and stresses the need for water retardation and soil erosion control works on land and headwater streams in addition to large downstream flood-control works. Gives brief data on the extent of soil removal by floods in the Des Moines River, upper Rio Grande, Yazoo River, and Southern California Coast basins. Notes that the Zuni Reservoir silted up to 70 percent of its capacity within 22 yr.; Raleigh Reservoir silted nearly 40 percent between 1914 and 1932. Emphasizes the importance of vegetative cover to hold water and control erosion.

COOLEY, LYMAN E.

1. Improvement of the Missouri River, at Nebraska City, Nebr. [extracts]. *Amer. Engin.*, vol. 11, no. 7, pp. 99-101, July 1880.

Conditions of bank erosion on the Missouri River at Nebraska City, Nebr., are given and proposed means of bank protection and stream improvement are discussed.

2. The Illinois River and the removal of the dams. *Ill. Soc. Engin. and Surveyors, Ann. Rpt.* 29, pp. 138-148, 1914.

Discusses the necessity for the removal of the dams of the Illinois River. Attributes the excessive silting and the raising of the bed of the stream to the existence of dams. Survey of 1903, 32 yr. after Henry Dam was closed, indicated that filling in broad and deep waters of the river and at the head of Henry Pool amounted in some localities to 10 ft. or more in depth, Lake Peoria, a natural lake, filled

nearly 50 percent chiefly during the last half of the period 1867-1903. During the 6 yr., 1883-1889, Lake Joliet, a natural lake, lost more than half its depth due to filling with detritus.

COOLING, LEONARD FRANK.

1. (and Skempton, Alec Westley). Some experiments on the consolidation of clay. *Inst. Civ. Engin. Jour.*, no. 7, pp. 381-398, illus., June 1941.

Outlines the oedometer test and describes a few simple experiments on samples prepared from London clay. Tests show that the London clay yields results which agree with the theory of the consolidation of clays advanced by Professor Karl von Terzaghi.

2. (and Skempton, Alec Westley). A laboratory study of London clay. *Inst. Civ. Engin. Jour.*, no. 3, pp. 251-276, illus., Jan. 1942.

Describes a laboratory study of a large number of disturbed and undisturbed samples of London clay. Determines index properties on 104 samples and examines variations of properties; mechanical values can be correlated with index properties, the compressibility and shear stress being related to liquidity-index and the coefficient of consolidation to the liquid limit.

COOPER, WILLIAM S.

1. Vegetational development upon alluvial fans in the vicinity of Palo Alto, California. *Ecology*, vol. 7, no. 1, pp. 1-30, illus., Jan. 1926.

Deals with the bionomics of the alluvial fans in the vicinity of Palo Alto, Calif. Includes four paragraphs dealing with the origin of tidal flats and alluvial fans, and notes present progress of fan building at mouth of San Francisco Creek.

COOPERRIDER, CHARLES K.

1. (and Hendricks, Barnard A.). Erosion on the upper Rio Grande. *Science*, vol. 84, no. 2174, p. 203, Aug. 28, 1936.

Reports on a study conducted by the U. S. Forest Service relating to research on forest and range lands. Natural vegetation on the watershed of New Mexico above Elephant Butte Dam has deteriorated because of overgrazing, timber cutting, fire, and injudicious dry farming resulting in accelerated erosion, silt-bearing floods, threatened destruction to irrigation agriculture, and displacement of water-storage capacity of Elephant Butte Reservoir by silting.

2. (and Hendricks, Barnard A.). Soil erosion and stream flow on range and forest lands of the upper Rio Grande watershed in relation to land resources and human welfare. *U. S. Dept. Agr., Tech. Bul.* 567, 88 pp., illus., May 1937.

Describes the damaging effects of soil erosion and floods on range and forest lands of the upper Rio Grande watershed. Considers the following subjects: channeling of alluvial lands, silting up of reservoirs and irrigation canals, stream channel sedimentation, control measures, bed-load movement, etc. Notes evidences of accelerated erosion, trenched valleys, recent arroyo formation, flood damages, sediment damages, and stream-bank erosion. Points out that in 17 yr. (1915-31) accumulation of silt in Elephant Butte Reservoir amounted to 337,939 acre-feet. Gives data on the quantity of silt carried in suspension by the Rio Grande past San Marcial during 1904 and 1905.

COPELAND, WILLIAM R. See Fuertes, J. H., 1.

COPPEE, H. ST. L. See also Ockerson, J. A., 4.

1. Bank revetment on the lower Mississippi. *Amer. Soc. Civ. Engin., Trans.*, vol. 35, pp. 141-222, illus., July 1896.

Gives a comprehensive account of bank-protection work on the lower Mississippi River. Describes the different kinds of revetment to protect banks of the river from erosion, costs, construction details, and effectiveness. Descriptions of works at Vicksburg, Goldsboro Bend, New Orleans, Memphis, Columbus, Helena, Ashport Bend, and Daniels Point are given.

Discussion: E. E. TRATMAN, pp. 223-224, describes briefly fascine-matress construction on the upper Mississippi River, brush

dike construction on the James River, use of suspended mattresses on the River Isar, Bavaria, and mattress revetment for shore protection on Lake Erie. WILLIAM STARLING, pp. 225-227, treats of the possibility of bank protection by natural sedimentation. Economic aspects of the problem are examined. Conditions of erosion at the foot of revetments and selections of sites for the beginning of revetment work are noted. D. M. CURRIE, p. 227, notes the success of the woven mattress for bank protection between St. Louis and the mouth of the Ohio River since its adoption in 1881. W. C. PRICE, pp. 228-230, considers the effectiveness of various types of fastenings used in dike and mattress construction on the Mississippi River, noting the effect of corrosion and the impact of suspended material on fastenings. ALFRED NOBLE, pp. 230-237, considers the problem of the use of operation materials in revetment construction. Describes conditions of erosion and bar formation at Hopefield Bend above Memphis, bank protection by subaqueous woven mattresses at that point and at Memphis Bridge, and costs. THE AUTHOR, pp. 237-240, points out differences in the structural and economic aspects of revetment construction in Europe and in the United States. Discusses scouring at the foot of mattresses, point of beginning for revetment work, natural accretions of sediment for bank protection, effectiveness of various types of revetment, and operating plant costs.

CORFITZEN, W. E. See also Shulits, S., 4, 6.

1. Second annual report (sixth progress report- 16th., 17th., 18th., and 19th. sets) on retrogression observations below Boulder Dam with notes on other silt investigations in the Colorado River and the Alamo Canal. 16 pp., tables, graphs. Denver, Colo., U. S. Bur. Reclam., Off. Chief Engin., 1937. Gives results of observations on retrogression, suspended load, velocity measurements, and bed material in the Colorado River. A resumé of all observations to date is included.

2. Retrogressions below Boulder Dam. *Reclam. Era.*, vol. 27, no. 10, p. 240, Oct. 1937.

Deals with retrogression below Boulder Dam on Colorado River since Feb. 1935. Bimonthly studies of changes along bed downstream before dam was built, show discharge varied from 3,000 to 200,000 cu. ft. per sec. with average silt content of 330 tons per min. past a given point, but river slope remained 2 ft. per mile. Fifty percent of silt was less than 0.0025 in. in diameter. Lake Mead now impounds 15,000,000 acre-feet of water. Desilted water from lake, two years after closure of dam, transports particles of 0.394 in. average diameter compared to 0.0098 in. at time of closure. Degradation two miles below dam reaches a maximum of 12.5 ft. Average degradation of first 8 miles below dam is 6.7 ft. Degradation ceases 50 miles below dam. River carries three times as much silt 237 miles further downstream as at this point, indicating further pick-up of fine material no longer available in first 50 miles. Degraded material amounted to 12,000,000 cu. yd. in 25 mo. Retrogression is an important factor in design of irrigation intake structures and power plant draft tubes.

3. Third annual report on retrogression observations below Boulder Dam with notes on other silt investigations on the Colorado River and the Alamo Canal and salinity studies conducted at Yuma, Topock, Willow Beach and Grand Canyon on the Colorado River. 22 pp., tables, graphs. Denver, Colo., U. S. Bur. Reclam., Off. Chief Engin., 1938. Gives data on suspended load and salinity and includes a resumé of all observations taken to date. Bed samples were taken. Gives results of mechanical analyses of sediment.

4. Fourth annual report on retrogression observations and salinity studies on the Colorado River and suspended load investigations on the Colorado River, Yuma Main Canal, and Alamo Canal. 23 pp., tables, graphs. Denver, Colo., U. S. Bur. Reclam., Off. Chief Engin., 1939.

Presents results of observations on retrogression, salinity, and suspended load in the Colorado River. Gives data on bed load, suspended load, and salinity. Data on mechanical analyses are included.

5. (and Vetter, C. P.). A study of the effect of silt on absorbing light which promotes the growth of algae and moss in canals. 7 pp., tables, graphs. Washington, U. S. Bur. Reclam., 1939.
A study of the introduction of silt into the water of a canal so as to eradicate moss and algae. This study deals with a specific problem at the Ogden River irrigation project in Utah.
6. Fifth annual report on retrogression observations, salinity studies, and suspended load investigations - Colorado River basin, 22 pp., tables, graphs. Denver, Colo., U. S. Bur. Reclam., Off. Chief Engin., 1940.
Deals with results of various observations on the Colorado River. Gives data on retrogression observations below Boulder and Parker Dams. Includes suspended-load studies on the Colorado River, Yuma Main Canal, and Alamo Canal, and salinity studies in the Colorado River.
7. Silt problems. Civ. Engin., vol. 12, no. 11, pp. 616-619, illus., Nov. 1942.
Deals with effect of silting on irrigation canals and irrigated fields, in irrigation reservoirs and in harbors and rivers. Notes causes of accelerated erosion. Studies of silt problems conducted by Government agencies are given.

CORPS OF ENGINEERS. See U. S. Engineer Dept.

CORTHELL, ELMER L.

1. The South Pass jetties—ten years practical teachings in river and harbor hydraulics. Amer. Soc. Civ. Engin., Trans., vol. 13, pp. 313-330, Oct. 1884.
A paper on results of jetty construction at the South Pass of the Mississippi River. Describes in detail bar formation at the mouths of the passes. Discusses the effect of the jetty system on the growth of shores of the Pass by deposition of sediment, on scouring of the channel to navigable depth, and on the advance of the bar seaward.
Discussion: C. B. COMSTOCK, (Amer. Soc. Civ. Engin., Trans., vol. 15, pp. 230-232, Apr. 1886), notes that scour arises from filling and emptying of interior areas and that works which interfere with filling would affect scour. The advance of the shore line at the mouth of the Mississippi River prior to jetty construction was 100 ft. per yr. Water issuing from jetties with higher velocity carries sediment farther out than previously, resulting in lesser advance of shoal contours. No support is given to the belief that jetties will retard the permanent advance of sedimentary bars and without prolongation will maintain a 30-ft. channel.
R. E. MCMATH, pp. 246-249, comments on hydrodynamics which characterize and constitute silt-bearing rivers. Existence or non-existence of surplus energy in a river explains why the jetty plan of concentration and other plans and suggestions must fail. Notes that levees, outlets, and cut-offs increase the residue of destructive energy and are incompatible with stable conditions which permanent improvement must attain. J. F. BARON, pp. 263-266, notes that the effect of jetties on the advancing bar at the South Pass of the Mississippi River may be dismissed unless jetties are to be extended or littoral current is of sufficient velocity to move aside continual deposits.
2. Improvement of river mouths. Engin. Rec., vol. 26, no. 13, pp. 199-200, Aug. 27, 1892.
Describes results and efficiency of jetty construction at mouths of sediment-bearing rivers to remove bars deposited and maintained by action of river and sea forces. Gives table of depths at mouths of seven German rivers improved by jetties. Similar improvements in other European countries noted. Discusses effect of wind, tide and current on bar formation and the formation of delta at mouth of the Mississippi River. Describes work of Captain

Eads at South Pass of Mississippi River also that of the Brazos River Channel and Dock Co. at mouth of Brazos River, Tex.

3. Contracting and regulating works at mouths of rivers. Pan Amer. Sci. Cong., 2d, Proc. Sect. 5, Engin., vol. 6, pp. 262-375, 1915-16.
Discusses principles of river engineering and offers rules for designing and constructing contraction and regulation works. Cites examples of engineering works at the mouths of the Mississippi, Panuco (Mexico), and Rio Grande Rivers. Sediment transportation and deposition at the mouths of these streams reported.

CORY, H. T. See also Schobinger, G., 1.

1. Closing the break of the Colorado River into the Salton Sink, southern California. Engin. News, vol. 56, no. 26, pp. 671-674, illus., Dec. 27, 1906.
Describes attempts at closing break of the Colorado River into Salton Sink in southern California. Gives general description of Salton Sink also methods employed by the California Development Co., from 1901-1904, to divert waters of the Colorado River for irrigation purposes and subsequent silting of canal. Canal widens and deepens during rise of river. Gives general description of the Colorado and Gila Rivers noting that the Colorado is heavily charged with silt and often changes its channel. Silting and scouring make closing a break difficult.
2. Irrigation and river control in the Colorado River Delta. Amer. Soc. Civ. Engin., Trans., vol. 76, pp. 1204-1453, illus., 1913.
Presents in general, a description of conditions of irrigation and stream control in the delta region of the Colorado River. Aspects of delta formation are discussed, noting conditions of its extension into the Gulf. Discusses the effects of erosion and sedimentation in the stream channel on changes in longitudinal and cross-sectional profiles. The average annual sediment discharge of the Colorado, 1894-1911, at Yuma is estimated at 71,800 acre-feet, based on 93 lbs. per cu. ft. of dry sediment (Forbes). Conditions of overflow and character of local silt deposits are described. Discusses the engineering features of irrigation works in the Imperial Valley with particular reference to methods of excluding silt from canals and canal maintenance, the seriousness of the silt problem in diverting Colorado River water, and the fertility of Imperial Valley soil. Erosive effects of the floods of 1906 are briefly described, and data on dredging are given.
Discussion: L. J. LE CONTE, pp. 1454-1455, notes that rich, fertile Colorado River sediment is discharged during rising river stages and undesirable silt during high water and falling stages. Adequate regulation of the gates of Laguna Weir is needed. Discusses briefly Kennedy's formula as an aid to silt control. Compares the cost of Laguna Weir and the Kistna Anicut in India. Notes the unreliability of rating curves. FRANCIS L. SELLEW, pp. 1456-1506, examines the possibilities for stream control on the Colorado by the use of storage reservoirs. Data by Forbes and the U. S. Reclamation Bureau, on quantity of sediment carried and deposited in the lower Colorado River are presented to prove that reservoirs for permanent stream control must be situated at headwaters to avoid problems of reservoir silting. The real problem of the Colorado is bank protection. Cites damage by the flood of 1912 on the lower Colorado. The future work of bank protection should be directed to the strengthening of levees, river regulation, dredging, and revetment works. W. W. FOLLETT, pp. 1511-1513, treats of the approach of an epochal change in the course of the Colorado River across its delta, observed in March 1903, which subsequently resulted in a diversion into Imperial Valley via Abejas Crevasse. States that no further grade recession will occur as the river is tending to raise its bed and a new delta is forming pointing toward Volcano Lake. Proposes levee protection of Imperial Valley and a safety gate below

- Hind Dam to prevent diversion into the Salton Sea. Discusses the scouring effect of floods and currents on the banks and bed of the river. C. E. GRUNSKY, pp. 1533-1542, describes the effects of levee construction on the regimen of the Colorado River, noting conditions of erosion and sedimentation. Criticizes engineering aspects of the Laguna diversion works, with particular reference to the problem of the disposal of silt and other obstructions. CLARENCE K. CLARKE, pp. 1545-1555, examines the need for bank protection works to maintain a defined course for the Colorado River and increase the scouring action of floods and their silt-carrying capacity. The use of rock and gravel to protect levees from undercutting is described. Cites an example at the California Development Co. levee, Gila River, noting conditions of induced sedimentation. Discusses bank protection at the Palo Verde Intake of the Colorado by means of a fascine jetty; dredging in Imperial Valley Canals.
- COTTON, SIR ARTHUR. See Voelcker, J. A., 1.
- COTTON, C. A.
1. Landscape as developed by the process of normal erosion. 301 pp., illus. Cambridge, Eng., Univ. Press, 1941.
A textbook on the elementary principles of geomorphology. Treats such subjects as mass movement of waste, rain and rivers, cycle of erosion, lakes as young consequent features, landscape in youth and maturity, terraces, peneplains, base-level, meandering and lateral corrosion of rivers, and structural land forms.
- COTTON, JOHN S. See Wilm, H. G., 1.
- COUTTS, JOHN R. H.
1. (and others). An automatic and continuous recording balance (the Oden-Keen balance). Royal Soc. London, Proc., Ser. A., Math. and Phys. Sci., vol. 106, no. A735, pp. 33-51, illus., July 1, 1924. Edward M. Crowther, Bernard A. Keen, and Sven Oden, joint authors.
Describes an automatic and recording balance which records smaller changes of weight than is possible with metal spheres; the control being effected electromagnetically. Illustrates its application to the sedimentation and flocculation of soil particles.
 2. (and Crowther, E. M.). A source of error in the mechanical analysis of sediments by continuous weighing. Faraday Soc., Trans., vol. 21, pt. 2, pp. 374-380, Dec. 1925.
Notes a disturbance concerned with the balance pan which varies with the size of the particle and causes a distortion of the distribution curve.
- COX, CHARLES R.
1. Tests for turbidity. Water Works Engin., vol. 85, no. 6, pp. 314-316, illus., Mar. 23, 1932.
Describes the apparatus, procedure, and application of various methods used in turbidity determinations.
- COX, E. P.
1. A method of assigning numerical and percentage values to the degree of roundness of sand grains. Jour. Paleontol., vol. 1, no. 3, pp. 179-183, illus., Dec. 1927.
Describes a method for assigning numerical and percentage values to the degree of roundness of sand grains.
- COZZENS, ARTHUR B.
1. Rates of wear of common minerals. Wash. Univ. [St. Louis] Studies, n. s. Sci. and Tech., 5, pp. 71-80, illus., Oct. 1931.
Presents results of tests in a mill on the loss of weight by wear of several common minerals. The wear of minerals of less hardness than that of quartz takes place mainly by abrasion. The wear of those of greater hardness is sufficiently affected by impact to vitiate the measurement of abrasion.
- CRADDOCK, GEORGE W. See also Bailey, R. W., 5.
1. Watershed management and sediment control. 10 pp. Ogden, Utah, U. S. Forest Serv., Intermountain Forest and Range Expt. Sta., 1947.
An address given at the meeting of the Association of Western State Engineers, Boise, Idaho, Sept. 10, 1947, includes comments on watershed management, control of sediment, accelerated erosion, floods, and watershed protection.
- CRAFT, E. A. See Blaess, A. F., 1.
- CRAFTS, H. A.
1. Difficulties of mountain irrigation engineering. Sci. Amer., vol. 79, no. 14, p. 214, Oct. 1, 1898.
Describes difficulties encountered in the operation of the North Fork irrigation ditch, Colo. Faulty ditch design caused considerable erosion in the canal and deposition of sand in the canal and upon adjacent lands. A series of badly planned trap floodgates make difficult the control of flood water and sand discharge from the ditch.
 2. A sand trap for irrigating ditches. Engin. Rec., vol. 54, no. 6, pp. 150-151, Aug. 11, 1906.
Describes construction and operation of a sand trap settling pool used on irrigation canal, Quito Creek, Santa Clara Valley, near San Jose, Calif.
- CRAIG, J. I. See Newell, F. H., 9; Willcocks, Sir. W., 4.
- CRAIGHILL, W. P. See also Ockerson, J. A., 1.
1. Some observations on the subject of the improvement of several rivers of the Atlantic Coast. Amer. Soc. Civ. Engin., Trans., vol. 19, pp. 233-251, illus., June 28, 1888.
Deals with the improvement of the approach to the harbor of Baltimore, and dredging improvement in the Patapsco River below Baltimore and in Chesapeake Bay below the mouth of the river. Navigation on the James River, Va., is hindered by obstructions, improved by dredging, rock excavation, and contraction and regulation of the waterway. Discusses merits of the dredge and regulating works, separately and collectively, as regards cost and successful operation in river improvement with reference to work done on the Mississippi at Grand Bayou. Navigation on the Appomattox River below Petersburg is hindered by bad shoal conditions, the harbor of the city constantly filling with sediment brought down by the stream. Improvements consist of a cut through Puddledock Marsh, dredging in the harbor, and regulating works below the town, dredged material being used for bank revetment. Dredging improvement of the Wicomico River is the same as that used on the Clyde in Scotland and on a number of streams on the Eastern Shore of Maryland. Briefly discusses improvement of the Cape Fear River.
Discussion: F. COLLINGWOOD, pp. 253-254, notes that observations sustained results of river improvement in which works aided nature in maintaining a navigable channel at Baltimore, Md. Caving banks of the James River necessitate improvements similar in character to those on the Mississippi River. O. M. CARTER, pp. 257-258, describes the work of scouring shoals in the channel of the Savannah River by the use of spurs or wing dams. Notes the suitability of both training walls and spurs on streams with easily eroded bottoms. WILLIAM H. BIXBY, pp. 259-267, describes the work and money spent on improving the Great Pee Dee River, S. C. Gives a general description of river improvement works on the Cape Fear River, N. C., by dike closures of minor channels, by jetty contraction of the main channel, and by dredging across shoals. WILLIAM R. HUTTON, pp. 267-270, mentions various factors involved in creating and maintaining a navigable channel at the entrance to Baltimore, Md. Notes the efficiency of spurs and training walls on the James River and observes the importance of the proper location.
- CRAMER, L. E.
1. The Coachella Branch of the All-American Canal. Reclam. Era, vol. 29, no. 10, pp. 274-275, 286, illus., Oct. 1939.
Presents a general preview of problems connected with the planning and construction of the Coachella Branch of the All-American Canal. Describes works for passing the canal under washes which carry boulders, sand, and silt during sudden floods of short duration.

CRANE, JACOB LESLIE, JR.

1. (and Olcott, George Wheeler). Report on the Iowa twenty-five year conservation plan. 176 pp., illus. [Des Moines, Iowa., Wallace-Homestead Co.], 1933.

Presents details of a 25-yr. conservation plan for Iowa. Discussion on conditions of silting, and proposed improvements for 38 natural lakes in the State is included.

CRAWFORD, G. L. See Nolla, J. A. B., 1.

CRAWFORD, L. C. See Stevens, J. C., 6.

CREAGER, WILLIAM P. See Grover, N. C., 12.

CREIGHTON, D. E.

1. Silty water made clear. *Ariz. Farmer*, vol. 24, no. 4, pp. 14, 19, Feb. 24, 1945.

Comments on the silt problem and its relation to farm crops. Notes use of desilting basins for farms, considers silt problem and notes method used on a farm near Joseph City, Ariz.

CRESSEY, GEORGE B. See Sharpe, C. F. S., 3.

CROSBY, IRVING B.

1. Geology in the making; erosion of a canyon in one night. *Boston Soc. Civ. Engin., Jour.*, vol. 15, pp. 33-35, illus., Jan. 1928.

Describes conditions of erosion and deposition caused by the Black River flood of Nov. 3, 1937, at Cavandish, Vt.

CROSBY, W. O.

1. A study of the geology of the Charles River estuary at Boston Harbor, with special reference to the building of the proposed dam across the tidal portion of the river. *Tech. Quart.*, vol. 16, no. 1, pp. 64-92, Mar. 1903.

A report presenting results of an investigation relative to the probable effect of a proposed dam upon conditions of shoaling in the Boston Harbor, and to determine the character of the substrata at the dam site. Discusses the rate of subsidence of the land in the Charles River estuary and rate of silting in the estuary. The probable effect of the proposed reservoir in reducing the average rate of silt deposition in the estuary is discussed.

CROSS, HARDY. See Freeman, J. R., 3.

CROSTHWAIT, PONSONBY MOORE.

1. The stability of channels through sandy estuaries. *Inst. Civ. Engin., Minutes of Proc.*, vol. 133, pp. 46-56, illus., 1898; [abstract], *Engineering*, vol. 65, p. 205, Feb. 18, 1898.

Discusses effect of channel training works in decreasing the quantity of water admitted and emitted by each tide, causing decrease in velocity and scouring capacity and resulting in increased silting up of the channel and accumulation of silt at channel entrance. Dredging has reverse effect. Describes works and results at Dundalk Harbour, Ireland.

CROWDER, A. F. See Blaess, A. F., 1.

CROWELL, J. FOSTER.

1. Characteristics of the Ravine Du Sud in the Island of Hayti, and plan for averting its overflow. *Amer. Soc. Civ. Engin., Trans.*, vol. 24, pp. 470-478, illus., June 1891.

Discusses the characteristics of the Ravine du Sud, Island of Hayti, West Indies. Describes features of ravine noting conditions of the transportation and deposition of erosion debris along its course. Notes damage in harbor caused by sand and mud deposits brought down in freshets, and describes proposed means of improving river.

Discussion: RUDOLP HERING, pp. 478-481, notes inconsistency in author's description of river bed and velocity obtained by Stevenson's formula. States that velocity of 1418 ft. per sec. would transport small gravel in suspension. W. E. MERRILL, pp. 481-483, notes similarity between Ravine du Sud and torrents in French Alps. Discusses regulation of torrents carrying supply of traveling material. FRANZ A. VELSCHOW, pp. 483-488, reports the effect of changing outlet of a ravine or river on harbor silting and flood prevention. THE AUTHOR, pp. 488-491, remarks on the impracticability of constructing an outlet for Ravine du Sud through Islet River noting that Islet River is a silt-bearer and silting up its bed is considered. Notes that Ravine under existing conditions cannot scour and maintain its harbor.

CROWTHER, EDWARD M. See also Coutts, J. R. H., 1, 2.

1. The direct determination of distribution curves of particle size in suspension. *Soc. Chem. Indus., Jour., Trans. and Commun.*, vol. 46, pp. 105T-107T, illus., Mar. 25, 1927.

Describes an apparatus for obtaining continuous size-distribution curves of suspensions through measurements of the changes with time of the density at a given depth. Uses a highly-sensitive differential liquid manometer connected between two points near the base of the sedimenting column in order to secure magnification for direct readings.

2. Nomographs for use in mechanical analysis calculations. *Internatl. Cong. Soil Sci. 1st. Proc. and Papers*, pt. 2, pp. 399-404, illus., 1928.

Points out the importance of a temperature correction for the velocity of water in mechanical analysis. Presents nomographs for use in calculations in mechanical analysis. Notes that nomograph A is to be preferred for the simple temperature correction of a known settling velocity, and nomograph B is to further convenient interchange of units.

CROZER, JOHN P. See Smith, G., 1.

CRUGNOLA, GAETANO.

1. The relation of the bed of a river to the water which flows in it [abstract]. *Inst. Civ. Engin., Minutes of Proc.*, vol. 144, p. 345, 1901.

The conditions which determine the windings of a river, the relation of the form of transverse section to the variations of depth along its course, and the formation of sand and gravel deposits and their reaction on the banks and bed of a river lower down are discussed.

CRUSE, R. E.

1. Structures to control torrents. *Engin. News-Rec.*, vol. 119, no. 2, pp. 67-72, illus., July 8, 1937.

Deals with structures built to conform to flood control plans of Los Angeles County Flood Control District, particularly debris basins and dams at mouths of mountain canyons and channel enlargement of streams carrying off flood waters. Works in Los Angeles River, Ballona Creek, Verdugo Channel, Verdugo, Wash., Sycamore Wash, Rubio Wash, Alhambra Wash, Compton Creek, Kenter Canyon and Eaton Wash is noted. Debris basins at Verdugo, Wash., (La Crescenta-La Canada and Haines) and at Eaton, Wash. are described.

CULBERTSON, GLENN.

1. The flood of March 1913, along the Ohio River and its tributaries in southeastern Indiana. *Ind. Acad. Sci., Proc.*, pp. 57-61, illus., 1913.

A report of damages along the Ohio River and its tributaries in southeastern Indiana due to the flood of March 1913. Erosion of steep hillsides, landslides, and deposits on bottom land varying in depth from 6 in. to 12 in. were caused by the flood. Fertility of deposits is noted. Points out damages to crops.

CUMINGS, E. R.

1. The geological conditions of municipal water supply in the driftless area of southern Indiana. *Ind. Acad. Sci., Proc.*, 1911, pp. 111-146, illus., 1912.

Deals with geological conditions in the driftless area of southern Indiana from the standpoint of water supply. A geologic description of the area and the alluvial fans characteristic of the larger valleys are given. Discusses the water producing qualities of the valley, climatological data, proposed dam, completed Indiana University Dam, drainage. Soil erosion due to denudation in southern Indiana; gullying; changes of stream regimen; effect of denudation on frequency and volume of floods, the sediment content of streams, and conditions of reservoir silting. Notes effects of denudation and erosion on the silting up of reservoirs in the southern Appalachian region (U. S. Geol. Surv., Prof. Paper 72, 1911, by L. C. Glenn).

CUNNINGHAM, ALLAN.

1. Recent hydraulic experiments. *Inst. Civ. Engin., Minutes and Proc.*, vol. 71, pp. 1-36, 1883.

Deals with experiments on the flow of water in the Ganges Canal in Northern India during the period 1874-1879. A detailed report was published in 1881. Measurements were made of

the distribution and amount of silt in the canal. Notes that silt density in no way depends on the depth or velocity in the Ganges Canal but depends on the state of the supply water from the Ganges.

CUNNINGHAM, E.

1. On the velocity of steady fall of spherical particles through fluid medium. Roy. Soc. London, Proc., Ser. A, Math. and Phys. Sci., vol. 83, no. 563, pp. 357-365, Mar. 2, 1910.

Deals theoretically with two of the main sources of divergence from Stokes' law. Considers the deviation expected because of a small diameter and the effect of the simultaneous presence of a large number of particles moving with the same velocity through a fluid.

CURD, W. C.

1. Bank protection and restoration; a problem in sedimentation. Amer. Soc. Civ. Engin., Trans., vol. 84, pp. 303-321, illus., 1921; also in Engin. and Contract., vol. 54, no. 19, pp. 459-461, illus., Nov. 10, 1920; [abstract], Engin. and Contract., vol. 55, no. 3, pp. 58-59, illus., Jan. 19, 1921.

Deals with the protection and restoration of a sliding bank along the Mississippi at Natchez, Miss.; the tracks of the Natchez and Southern Ry. rest upon the bank. Describes the application of the sedimentation process to the replacement of the river bank which had been carried away by caving and erosion. Sedimentation was produced during floods by the construction of a mud-cell dike; after required sedimentation had been acquired, the exposed banks were permanently protected with concrete slab paving.

Discussion: L. M. ADAMS, pp. 322-325, describes conditions of bank caving on the Rio Grande at Fort Brown, Tex., remedied by use of weighted brush mattresses. R. W. MACINTYRE, pp. 325-328, describes works to protect from erosion the foundation of Capilano Bridge, B. C., Canada; cribs and brush mattresses protect banks at piers. Conditions of stream meandering during construction of the bridge are discussed. J. A. OCKERSON, pp. 328-329, notes the "retard" method of protecting banks of the Missouri River. Discusses briefly the effectiveness of mud cells as a bank protective measure. Notes that the protective measures employed depend upon the character of the stream. WILLIAM G. ATWOOD, pp. 329-330, shows the use of permeable dikes and a system of retards inducing sedimentation for bank protection along the Missouri. THE AUTHOR, pp. 330, answers some of the questions raised concerning the application and life of mud-cell construction.

CURRAN, CHARLES D. See Vogel, H. D., 8.

CURRIE, D. M. See Coppee, H. St. L., 1.

CURRY, WILLIAM H.

1. Recent shore line process, Brazoria County, Texas. Amer. Assoc. Petrol. Geol., Bul., vol. 24, no. 4, pp. 731-735, illus., Apr. 1940.

Describes the occurrence as seen in aerial photographs, of a sedimentary cloud northeast of the mouth of the Brazos River, Brazoria County, Tex., Jan. 20, 1939. Rainfall attending the storm of Jan. 12, 1939 caused great alluviation in the Brazos River mouth. A cyclone originating in the Mexican Plateau on Jan. 11, and moving northeastward caused currents which resulted in the northeastward movement of the cloud.

CURTIS, WINTERTON C. See Lefevre, G., 1.

CUSHING, FRANK HAMILTON.

1. Zuni breadstuff. N. Y. Mus. Amer. Indian, Heye Found., Indian Notes and Monog., vol. 8, 673 pp., illus., 1920.

Describes various rituals, agricultural methods, baking processes, etc., practiced by the Zuni Indians in making bread. Notes the use of a network of earthen embankments for diverting stream waters to enhance the fertility of agricultural lands by deposits from soil-laden waters.

CUSHMAN, ALLERTON S.

1. (and Hubbard, Prevost). Air elutriation of fine powders. Amer. Chem. Soc., Jour., vol. 29, pp. 589-597, illus., 1907.

Describes apparatus and method of air elutriation of fine powders which pass through the finest meshed sieves.

CUSTIS, G. W. P.

1. Valedictory address. U. S. Agr. Soc. Jour., 1857, pp. 68-73, 1858.

A valedictory address of farewell before the Society in which is included several paragraphs describing the production from silt deposits, or "pocosen," adjacent to the Potomac River. Fifty-five bu. of corn and 4 tons of timothy per acre was the calculated production.

CUTLER, J. S. See Simpson, W. F., 1.

DABNEY, A. L.

1. The Tallahatchie drainage district. Ill. Soc. Engin. and Surveyors, Ann. Rpt. 25, pp. 187-196, illus., Jan. 1910.

Discusses problems and plans for the improvement of drainage conditions by the Tallahatchie Drainage District. Notes method of and gives data on sediment determinations in the Coldwater, Tacona, and Tallahatchie Rivers. Volume-weight relationship of deposited silt is considered.

2. The success of the Mississippi River levees in the flood of 1922. Amer. Soc. Civ. Engin., Trans., vol. 87, pp. 987-992, illus., 1924.

Discusses the successful performance of the lower Mississippi River levees during the flood of 1922. Notes the importance of checking caving banks to protect levees.

DABNEY, T. G. See Starling, W., 2.

DAINES, NOLAN H.

1. Study of suspended sediment in the Colorado River. 26 pp., tables and graphs. Denver, Colo., U. S. Bur. Reclam., Br. Proj. Planning, 1949.

A study showing the relationship between sediment and discharge in the Colorado River basin using suspended load and discharge data taken from U. S. Geological Survey Water-Supply Papers. Presents sediment rating curves and double-mass analysis. Notes that not the total amount but the intensity, duration, distribution, frequency, and season of occurrence of precipitation are factors effecting variations in the runoff-sediment discharge relationship. Concludes that breaks in double-mass curves are results of climatic fluctuations and the approximate sediment load-runoff relationship will be expected to fluctuate.

DALLA VALLE, J. M. See also Twenhofel, W. H., 15.

1. (and Goldman, F. H.). Volume-shape factor of particulate matter; probable errors in the computation. Indus. and Engin. Chem., Analyt. Ed., vol. 11, no. 10, illus., pp. 545-546, Oct. 15, 1939.

Considers the determination of the volume of an aggregate of irregularly shaped particles which was determined from their average diameter. Concludes that the best value of the volume-shape factor is determined from the average particle weights of several aliquots of the aggregate.

2. Micromeritics, the technology of fine particles. Ed. 2, 555 pp., illus. New York, Pitman Pub. Corp., 1948.

A text which is intended to be a guide in the study of the behavior and characteristics of small particles from colloidal to sand size. Contains information on particle measurement, packing arrangements, chemical and physical properties, size-distributions, and includes a general theory dealing with physical properties of small, finely divided particles. Treats of such subjects as dynamics of small particles, theory of sieving, electrical properties, optical properties, sonic properties, diffusion of particles, infiltration and particle-moisture relationships, capillarity, behavior under pressure, determination of particle surface, muds, and slurries. A chapter on the transport of particles treats silt transportation, theories regarding transport, tractive-force theory, formulas for rate of silt movement, movement of sands and clays in pipes, and flow of muds and slurries in pipes. Includes formulas of Manning, Kennedy, Kramer, Schoklitsch, Chang, Rubey, Fabre, and Peter-Meyer, also includes a bibliography of selected references pertaining to the field of micromeritics. The study has a mathematical emphasis and contains tables of mathematical relations.

DALY, REGINALD A.

1. Marine currents and river deflection. *Science*, n. s., vol. 13, no. 337, pp. 952-954, illus., June 14, 1901.
An article on the effect of marine currents on river deflection, and their influence on the form of the delta. Describes phenomenon on the Mississippi River below Baton Rouge and on the Rhone and Ebro Rivers. States hypothesis of the force of the earth's rotation tending to produce left-hand deflection of an aggrading river in the northern hemisphere, thus producing strong asymmetry of a delta. Marine currents in case cited run in a direction which would control delta building in the same way as that expected from the influence of the earth's rotation.
2. The mystery of submarine "canyons." *Harvard Alumni Bul.*, vol. 38, no. 27, pp. 892-896, Apr. 24, 1936.
Discusses the origin of submarine canyons by density currents or sea water weighted with suspended sediment, during lowered sea-level stages of glacial epochs.
3. Origin of submarine "canyons." *Amer. Jour. Sci.*, ser. 5, vol. 31, no. 186, pp. 401-420, June 1936.
Offers a new hypothesis on the origin of submarine canyons. The lowering of the sea level during glacial stages of the Pleistocene Period and the action of wind and waves broke loose muds and sands from the continental shelves. Agitated sediment-laden water, with density exceeding that of cleaner sea water elsewhere, tended to slide down along the bottom of the continental slopes eroding the actual trenches. Includes discussion on the present action of density currents in the growing deltas of the Rhone and Rhine Rivers.

DANA, JAMES D.

1. Note on erosion. *Amer. Jour. Sci.*, ser. 3, vol. 12, no. 69, pp. 192-193, Sept. 1876.
Comments on paper by Gilbert entitled *The Colorado Plateau Province*. Deals with the eroding action of flowing water due directly to friction.

DANA, SAMUEL L.

1. A muck manual for farmers. Ed. 4, 312 pp. New York, A. O. Moore, 1858.
Considers geology of the soil, chemical constitution of rocks and soils, the properties and chemical action of the soil, its organic constituents, and the mutual action of organic and inorganic elements. Considers also manures, irrigation, physical properties of soils, bones, and the preparation of superphosphate of lime. Comments on the value of peat swamp muck and pond mud as a fertilizer. Gives the chemical constituents of suspended matter brought down by the Merrimack River during the floods of 1839.

DANA, SAMUEL T.

1. National forests and the water supply. *Amer. Forestry*, vol. 25, no. 312, pp. 1507-1522, illus., Dec. 1919.
Discusses effect of National Forests upon water supply. Notes that Trail Creek in Pike Forest, originally a clear stream, was completely altered in character by deforestation of its watershed. The flood of April 1914 buried 11 acres of irrigated farm land at mouth of creek with 18-30 in. of coarse gravel. Other damages have resulted from changes in forest cover in National Forests of the West.

DANA, STEPHEN W.

1. A pipette method of size analysis for the centrifuge. *Jour. Sedimentary Petrology*, vol. 13, no. 1, pp. 21-27, illus., Apr. 1943.
Describes a pipette method of size analysis for the centrifuge. Derives an equation which gives the relationship between the time required for sedimentary particles to settle into a specified distance in tubes of a microcentrifuge and the particle radius. Presents a procedure for the size analysis of fine-grained sediments.

DANEL, PIERRE F. See Howard, G. W., 1.

DANGLADE, ERNEST.

1. The mussel resources of the Illinois River. *U. S. Bur. Fisheries, Ann. Rpt.*, 1913, App. 6, 48 pp., illus., 1914.

Presents results of an investigation conducted during the summers of 1907-12 with regard to the mussel fisheries of the Illinois River. Notes several localities where the destruction of large mussel beds in comparatively recent times by means of mud and sand deposition has occurred.

DAPPERT, ANSELMO F.

1. Emergency work of the Division of Sanitation during the New York State flood of 1935. *New England Water Works Assoc. Jour.*, vol. 49, no. 4, pp. 376-394, illus., Dec. 1935.
Describes effects of flood of 1935 in New York State. Conditions of erosion in the hilly regions and of silt and debris deposition on flat lands and at the lower ends of small valleys are briefly described. Damages to public water supplies are noted.

DAPPERT, J. W.

1. Sedimentation, its relation to drainage. *Ill. Soc. Engin. and Surveyors, Ann. Rpt.* 21, pp. 82-93, Jan. 17-19, 1906; [abstract], *Engin. News*, vol. 55, no. 5, pp. 125-126, Feb. 1, 1906.

Presents data relative to siltage in drainage ditches and its relation to effective drainage. Illustrates factors producing sedimentation in natural streams. Describes features of graded streams, as exemplified by the Missouri River, discussing conditions of erosion and the transportation and deposition of sediment. Notes that a large volume of silt transported to the delta of the Mississippi River necessitates an average annual extension of 262 ft. to the jetties at the mouth of the stream. Describes briefly the action of the Mississippi in forming alluvial lands and building up its banks. In connection with the measurement of silt in streams, a method of sampling sediment (A. P. Davis) is described. Percentages of silt by volume, carried by the Brazos, Colorado, Gila, Ganges, Mississippi (at mouth) and Nile Rivers and the Rio Grande for various time periods, are given. Notes silting in Lake Austin of 48 percent in 7 yr. (1893-1900). States that during 1900 the Colorado carried an estimated 61,000,000 tons of sediment and that the Mississippi transports 812,500,000,000 lbs. of sediment annually. Observations on sedimentation in drainage ditches, resulting in overflows by tributary creeks and the deposition of silt on agricultural lands, are given, noting that such deposits enrich the soil but are also destructive to farming operations. Conditions of sedimentation in the Coon River, Sny Island and Inlet Swamp Drainage Districts are described.

Discusses methods of preventing sedimentation in drainage ditches by the use of proper gradients, cross-sectional forms, adequate scouring velocities for various soil conditions, etc. Describes observations on scouring and the deposition of sediment in experimental ditches. Summarizes, in conclusion, factors necessary in the design of ditches to prevent erosion and the deposition of sediment.

Discussion: D. W. MEAD, pp. 93-94, considers in connection with the transporting power of a stream, the movement of bed material, noting conditions in the Coal River, W. Va., and behind a concrete dam at Danville, Ill., where material rolled along the bottom of the stream and, in a period of 18 mo., formed a deposit behind the dam 10 or 11 ft. in depth extending back 100 or 150 ft. from the dam with a width of about 290 ft. Notes the need for research on the reservoir-silting problem.

DAPPLES, E. C.

1. (and Rominger, J. F.). Orientation analysis of fine-grained clastic sediments: a report of progress. *Jour. Geol.*, vol. 43, no. 4, pp. 246-261, illus., July 1945.

Extends methods of orientation analysis to fine-grained clastic sediments so as to determine character of their last environment of deposition. The nature and direction of the depositing agent is considered. Study shows that grains from a laboratory fluvial environment exhibit a preferred elongation parallel to the flow of the depositing agent and tend to lie with the larger ends upstream, thus making it possible to determine the source of direction.

DARBY, G. M. See Bull, A. W., 1.

DARLING, J. N.

1. Man's blind attack on nature. Better Homes & Gardens, vol. 14, no. 8, pp. 31, 121-123, Apr. 1936.

Describes injurious effects of water power, drainage, reclamation and flood-control projects, specifically Santee-Cooper project in South Carolina and Currytuck Sound project in North Carolina. Also describes silting of the reservoir behind Keokuk Dam and its effect on the pearl-button industry at Muscatine, Iowa.

2. Speaking of flood control. Amer. Water Works Assoc. Jour., vol. 37, no. 4, pp. 345-349, Apr. 1945.

Discusses flood control and comments on the sediment problem. Calls attention to the amount of silt carried by the Missouri River and its effects on recreation, plant and animal life. Comments on the program of flood control and MVA.

DARROW, F. T.

1. The Burlington Railroad and the Republican River floods of 1935. West. Soc. Engin. Jour., vol. 41, no. 2, pp. 66-74, illus., Apr. 1936.

Describes damages to the Burlington Railroad due to the Republican River floods, May 30-June 4, 1935. Notes that the formation of new cut-offs resulted in channel scour at some points and that the valley floor was subject to erosion and deposition.

DARWIN, G. H.

1. On the formation of ripple-mark in sand. Roy. Soc. London, Proc., vol. 36, no. 228, pp. 18-43, illus., Nov. 22, 1883.

Contains an account of observations and experiments concerning the formation of ripple-mark in sand. Describes the mode of formation and maintenance of irregular ripples by currents. Notes that the regular ripple-mark is due to a complex arrangement of vortices in oscillating water. Discusses some phenomena of the vortex motion of air and water.

DAVENPORT, R. W. See Lynch, H. B., 1.

DAVID, T. W. EDGEWORTH.

1. (and Guthrie, F. B.). The flood silt of the Hunter and Hawkesbury Rivers. Roy. Soc. N. S. Wales, Jour. and Proc., vol. 38, pp. 191-202, 1904.

Presents data relative to the amount and fertilizing value of silt deposited during the floods of July 12, 1904, in the Hunter and Hawkesbury Delta areas, N. S. Wales. Describes the area of the Hunter Delta and the character and sequence of its deposits. Gives volumes of flood water and chemical analyses of flood water and silt. Discusses estimated rate of accumulation of silt of Hunter Valley in relation to the age of Hunter Delta. Includes a letter from R. Bailey to J. Hall noting the desire on the part of farmers to prevent floods, though they carry soil enriching elements, since the floods and their deposits destroy existing vegetable growth and necessitate alterations in agricultural practices (pp. 201-202).

DAVIDSON, R. L. See Aborn, R. H., 1.

DAVIDSON, W. C.

1. Bank protection. Engin. and Contract., vol. 66, no. 3, p. 103, illus., Mar. 1927.

Describes construction, costs, and results of timber revetment work for bank protection on the Rio Bonito near Lincoln, Lincoln Co., N. Mex.

DAVIS, ARTHUR POWELL. See also Kelly, W., 1; LaRue, E. C., 2; U. S. Senate. Committee on Irrigation and Reclamation, 1.

1. Report on the irrigation investigation for the benefit of the Pima and other Indians on the Gila River Indian Reservation, Arizona. 54th Cong., 2d sess., S. Doc. no. 27, pp. 3-56, illus., Dec. 1896.

A report on the investigation to provide irrigating waters for Gila River Indian Reservation. Includes information on the disposition of Gila River silt. Notes effect of silt in irrigating waters, rendering ground surface impervious and acting as lubricant to facilitate passage of water over it. Describes method of measuring amount of suspended matter in river at Buttes

(1895), noting that the percentage of silt by volume average 2.2 percent. Discounts possibility that projected Buttes Reservoir when filled would retain about 30 percent of available storage capacity in voids of material deposited. Desilting of reservoir by sluicing is not satisfactory for Buttes Reservoir. Progressive enlargements of the reservoir to provide sufficient storage is recommended. Describes plan for sluicing fine and freshly deposited material out of the reservoir by use of hydraulic giants.

2. Irrigation near Phoenix, Arizona. U. S. Geol. Survey, Water-Supply Paper 2, 98 pp., illus., 1897.

Discusses various aspects of irrigation in the Salt and Gila River valleys, Ariz. Includes discussion of the feasibility of constructing storage reservoirs with particular reference to the problem of reservoir silting. Discusses proposed methods of increasing storage capacity of reservoirs by the employment of large scouring sluices to remove silt deposits, by enlargement of reservoirs, and by hydraulicking out deposited material. Advises that reservoirs be located in side canyons or other basins having no considerable drainage to them, the water being carried through artificial conduits thus averting danger of filling reservoirs with silt. Notes that the amount of silt carried in such streams as the Gila can be determined only by impounding and measuring it.

3. Hydrography of Nicaragua. U. S. Geol. Survey, Ann. Rpt. (1898-99) 20, pp. 563-637, illus., 1899.

Presents results of observations by the Nicaragua Canal Commission relative to the proposed ship canal through Nicaragua. Includes observations on suspended and bed loads of the San Carlos and Sarapiquí Rivers (1898), sampling methods, and equipment.

4. Measurement of sediment. U. S. Geol. Survey, Water-Supply Paper 47, pp. 15-18, 1901.

Describes methods of suspended-load determinations of streams in Arizona, and physical characteristics of samples. Includes comments by Hazen with reference to the sediment carried by streams from a waterworks standpoint and by Fuller on turbidity determinations. Notes the method of determining turbidity by the measurement of opacity.

5. Water storage on Salt River, Arizona. U. S. Geol. Survey, Water-Supply Paper 73, 54 pp., illus., 1903.

Deals with various aspects of water storage on the Salt and Verde Rivers, Ariz. Discusses character of Salt and Verde River drainage basins, discharge of streams, construction plans for dam above Mount McDowell equipped with Stoney gates to discharge maximum quantity of silt, specifications for the construction of Salt River Dam, sediment in Salt River water and its effect on proposed storage, and outlet works for silt removal from reservoir. Presents analyses of limestone and clay from Salt River used in cement manufacturing.

6. Investigations in New Mexico, 1902-1903. U. S. Reclam. Serv., Ann. Rpt. 2, pp. 375-395, illus., 1904.

Presents results of investigations by the U. S. Reclamation Service in New Mexico (1902-03). Includes brief discussion of proposed means of preventing silt deposition in the reservoir of the Hondo River project.

7. Irrigation on the Royal Murgab Estate, Turkestan, Russia. Engin. News, vol. 67, no. 13, pp. 621-624, illus., Apr. 4, 1912.

Describes irrigation systems in western Turkestan, Russia. Includes one paragraph noting that the 10,000 acre-foot reservoir behind Hindu Kush dam, which was built in 1895, is now (1912) nearly filled with sediment most of which came in with floods of April and May 1903.

8. Address...at the dedication of the Elephant Butte Dam, N. Mex., Oct. 19, 1916. Reclam. Rec., vol. 7, no. 12, pp. 554-556, Dec. 1916.

An address delivered at the dedication of Elephant Butte Dam recapitulating problems involved in the construction of the dam. Discusses the future silt problem in the reservoir and notes that at an estimated rate of 20,000

acre-feet per yr., 1,000,000 acre-feet of mud will be deposited in 50 yr. creating a "sea of mud for 40 miles." Since the reservoir will run dry, the last water through will cut a channel, return seepage will irrigate, and erosion of the channel will provide more capacity for storage. Suggests that Elephant Butte Dam can be raised 30-40 ft. higher if necessary, or an auxiliary reservoir can be built in the Jemez Mountains, the latter to supply the former when dry.

9. (and Wilson, H. M.). Irrigation engineering. 617 pp., illus. New York, John Wiley and Co., 1919.

A technical book on irrigation engineering, discusses comprehensively all phases of irrigation problems and practices. Includes one chapter on sedimentation of reservoirs. Discusses feasibility of storage reservoirs on streams carrying large quantities of solid matter and, where feasible, the problems of discarding most of the material. Efforts to determine a factor to express the relation between dry weight of silt and volume of deposited sediment in a reservoir are noted. Describes observations of silt carried in suspension by Rio Grande. Tables show silt in Rio Grande passing San Marcial, N. Mex. 1897-1912 (W. W. Follett). Notes that a reservoir, if constructed on this stream, would have its capacity seriously impaired in a short time unless methods of prevention are used. From study of scattered observations of silt transported by the Gila River, D. E. Hughes concludes that the water carried solid matter equal to an average of 1.3 percent of its volume. From results of experiments in India and America, Etcheverry concludes that 1 cu. ft. of saturated silt settled in a tube for 1 yr. contains about 30 lbs. of dry silt, 1 cu. ft. of moist silt deposited under natural conditions in river or on field will contain about 50 lbs. of dry silt, and 1 cu. ft. of dry silt will weigh 90 lbs. Discusses sediment rolled along bottom of streams in dunes, describing measurements made by Nicaragua Canal Commission (1898). Discusses removal of silt from reservoirs, noting means employed at Assuan Dam on Nile River, Egypt. Describes plan to solve silt problem of Elephant Butte Reservoir on Rio Grande by making provisions for increasing the height of the dam to form a reservoir nearly twice the required capacity when original capacity is decreased and by constructing several smaller reservoirs on headwaters of the stream and tributaries when the reservoir at Elephant Butte is filled with mud. Describes method of handling silt in Elephant Butte Reservoir as proposed by W. W. Follett.

10. Flood problem in the arid region. Amer. Soc. Civ. Engin., Trans., vol. 85, pp. 1483-1487, 1922.
Describes action of muddy streams such as the Colorado and Mississippi Rivers which increase their length as a result of delta deposits. Points out the tendency of these streams toward self-regulation by building up river channels and the creation of flood plains by overflow. Contends that most of the world's fertile valleys are flood plains which are in constant danger of overflow. Outlines methods of flood control, particularly the employment of storage reservoirs, and notes several sites where their construction would be feasible.
11. Problems of Imperial Valley and vicinity. 67th Cong., 2nd sess., S. Doc. no. 142, 326 pp., illus., 1922.
Presents various data relating to problems of the Imperial Valley and vicinity and to construction of the Boulder Canyon Dam. Gives brief data on silt content and annual silt discharge of the Colorado River at Yuma and the Gila, Green, San Juan, Grand, and other tributaries. Discusses briefly the effect of developments above Boulder Canyon Dam on conditions of silting in the reservoir.
12. The Colorado River development. Amer. Soc. Civ. Engin., Trans., vol. 86, pp. 726-731, illus., 1923.
A paper on the proposed Colorado River development at Boulder Canyon. Includes conditions

of transportation and deposition of silt in the lower Colorado River. Describes briefly delta growth, building up of channel and banks due to sediment load of stream, and lateral oscillations of stream over its delta. Discusses feasibility of reservoir sites on the Colorado River, noting advantages of Boulder Canyon site. Notes that sediment delivered by lower Colorado is estimated at 90,000 acre-feet annually. Discusses provision for silt storage in proposed reservoir.

DAVIS, CALVIN V. See Rothery, S. L., 4.

DAVIS, CECIL N. See Allan, P. F., 1.

DAVIS, CHARLES E. L. B. See Ripley, H. C., 1.

DAVIS, H. S.

1. Stream improvement in national forests. North Amer. Wildlife Conf., Proc. 1936, pp. 447-453.
Discusses stream improvement work of the U. S. Bureau of Fisheries, including various types of dams and deflectors, check dams to hold back silt, removal of barriers, planting of trees, shrubs, and other vegetation.

DAVIS, MELVIN K. See Dryer, C. R., 3.

DAVIS, R. F.

1. The conveyance of solid particles by fluid suspension. Engineering, vol. 140, pp. 1-3, illus., July 5, 1935.

Establishes a general principal for the conveyance of solid particles in both liquids and gases including comparison of theoretical results with accepted practice. Rise of flaky or spherical particles into suspension is effected when the difference between the total pressure below and the static pressure above the particle exceeds the apparent weight of the particle. Discusses the velocity at which particles of various shapes commence to be taken up in suspension by a clear fluid passing horizontally over them (formulae), also saturation velocity of a horizontally flowing liquid conveying non-floating particles in suspension.

DAVIS, R. O. E.

1. Economic waste from soil erosion. U. S. Dept. Agr. Ybk. 1913, pp. 207-220, illus., 1914.
Discusses the processes of soil erosion by water, economic aspects involved, and applicable means for its prevention. Briefly describes effects of silting in stream channels and reservoirs on power development and navigation, and effects of dredging. Notes general silting of reservoirs on Catawba and Broad Rivers in South Carolina (testimony of W. S. Lee before Agricultural Committee, House of Representatives, 1908). Annual silt loads of the Hudson, Susquehanna, Roanoke, Alabama, Savannah, Tennessee and Missouri (above Ruedg, Mo.) Rivers, as reported by the U. S. Geological Survey, are given. Erosive action of streams is briefly described, noting conditions on the Columbia and Colorado Rivers. States that the Mississippi River carries to the Gulf 370,000,000-680,000,000 tons of suspended material annually, and estimates that total soil material removed to seas throughout the United States amounts to 820,000,000 tons annually. Economic aspects and rates of land-surface reduction for the Potomac and James Rivers are given. Describes methods of preventing soil erosion, particularly the use of earth or stone dams at lower portions of fields to check storm waters and induce sediment deposition. Protection of bed and banks at headwaters of streams briefly described.
2. Soil erosion in the South. U. S. Dept. Agr., Bul. no. 180, 23 pp., illus., 1915.
Deals with conditions affecting soil erosion as observed in a field study through the States of Virginia, Tennessee, Missouri, Alabama, Georgia, South Carolina, and North Carolina. Includes brief discussions on the translocation of soils by water, the physics of sediment transportation by water, damage to flood plains due to sediment deposition, and the economic aspects of stream and reservoir sedimentation.
3. Erosion in the Appalachian and Piedmont region. Amer. Forestry, vol. 25, no. 309, pp. 1350-1353, illus., Sept. 1919.
Treats the erosion problem in the Appalachian and Piedmont region. Removal of vegetative

covering from hills has resulted in filling river channels with silt, silting of reservoirs, and loss of power potentialities of streams. Notes that the Tennessee River carries to the sea annually 11,000,000 tons of silt; 3,039,000 tons are borne by the Alabama River, and the Roanoke, Savannah, and Susquehanna transport annually 3,000,000, 1,000,000, and 240,000 tons respectively.

4. The nature of soil components and their relations to sedimentation. Natl. Res. Council, Div. Geol. and Geog., Com. on Sedimentation, Rpt. 1924-25, pp. 44-48, 1925.

Notes the relationship to sedimentation of the mechanical analysis of soils, the significance of soil colloids, methods for separating colloids from the soil, deflocculation of soil constituents, chemical composition of the colloids, the relation between silica and alumina in the colloids, difference between composition of soils and colloids extracted from them, factors affecting the composition of colloids, the presence of compounds in colloidal material, relation of binding power of soils to the colloidal content, heat of wetting as a measure of colloidal content, and the effect of cations upon the chemical composition of soil colloids.

5. Colloidal determinations in mechanical analysis. Amer. Soc. Agron., Jour., vol. 17, no. 5, pp. 275-279, May 1925.

Notes that the presence of colloid in soil should be expressed in mechanical analysis. The water absorption method may be employed for indirect determination of the colloid. With care the colloidal aggregates and films in sand groups may be separated and dispersed from sands.

DAVIS, R. W.

1. Colorado River - silted channel dredging is planned. West. Construct. News, vol. 22, no. 10, pp. 71-76, Oct. 1947.

Comments on the rise of the Colorado River which threatened inundation of an alluvial valley in the Needles area. Discusses use of amphibious vehicles in surveying swamp areas. Need of channel clearance is given and conditions for designing a large demountable dredge are included.

DAVIS, W. M.

1. The development of river meanders. Geol. Mag., decade 4, vol. 10, no. 4, pp. 145-148, illus., Apr. 1903.

Attributes the formation of meanders to erosion of the banks of the main stream and not to the deposition of sediment by tributary streams.

2. Meandering valleys and underfit rivers. Assoc. Amer. Geog. Ann., vol. 3, pp. 3-28, illus., 1913. Considers the relation between the small-curved meanders of a river and the larger-curved meanders of its valleys, or a relation that is "underfit." Deals with meanders and their development, widening of a flood plain, and underfit rivers.

DAVIS, WILLIAM G.

1. Wildlife will come where it is invited. Mo. Wildlife, vol. 2, no. 5, pp. 7, 11, illus., Dec. 1939. Discusses the use of ponds in erosion control and the development of pond areas for wildlife (Dubois Creek erosion-control demonstration, Washington, Mo.). Notes measures to be employed to prevent silting in ponds.

DAWSON, F. M.

1. Control of navigable channels. Kans. Engin. Soc., Proc. 20, pp. 28-32, 1928.

Describes river-training works which have made the Missouri River suitable for navigation. Discusses a few general items on river hydraulics, and notes the need for laboratory study of hydraulic problems relative to the improvement and control of navigable streams.

DEACON, G. F. See Vernon-Harcourt, L. F., 4.

DEAN, BASHFORD.

1. The physical and biological characteristics of the natural oyster grounds of South Carolina. U. S. Fish Comm. Bul., (1890) vol. 10, pp. 335-361, illus., 1892.

Presents results of investigations by the United States Fish Commission on the physical and

biological characteristics of oyster grounds of South Carolina. Includes discussion on the effect of bed and suspended silt in streams upon oyster development.

DEAN, H. J. See Follansbee, R., 1.

DEAN, SETH.

1. The Nishnabotna River improvement. Iowa Engin. Soc., Proc., 16, pp. 21-29, illus., 1904. Discusses proposed plans for the improvement of the Nishnabotna River, Iowa. Briefly describes conditions of the bed and bank of the stream noting effect of silting in the stream on flood heights.
2. The maintenance of drainage ditches. Iowa State Drainage Assoc., Proc. (1908) 5, pp. 28-29, 1909. Discusses conditions of erosion which cause siltation in drainage ditches and describes methods of silt removal and ditch maintenance.
3. Maintenance of small drainage ditches. Iowa State Drainage Assoc., Proc. 10, pp. 47-50, 1914. Describes conditions of sedimentation in and methods and costs of maintenance of small drainage ditches in Iowa.

DE BERARD, W. W.

1. Today in the Mississippi flood area VIII. Revetment and some river hydraulics. Engin. News-Rec., vol. 100, no. 11, pp. 434-439, illus., Mar. 15, 1928; [abstract], Sci. Amer., vol. 139, no. 8, pp. 158-159, illus., Aug. 1928.

Describes construction and use of concrete mats to prevent erosion at bends along one section of the Mississippi River.

DEBLER, E. B. See also Kelly, W., 1; Sonderegger, A. L., 2.

1. Duty of water in terms of canal capacity. Civ. Engin., vol. 2, no. 9, pp. 546-548, illus., Sept. 1932.

Deals with problems to consider in constructing irrigation canals and ditches. Notes power of silt to seal banks and reduce capacity of canal or ditch, clogging of canals by detritus brought in by storms, vegetation on banks which catches finer materials, allowances in area of cross section of canal for impaired capacity and to avoid losses by percolation, and concrete-lined canal on Umatilla project in North Central Oregon where sufficient velocity could not be provided to carry heavy sands to wasteways. Describes templet devised to clean canals on Umatilla project.

DE BOER, S. R.

1. State of New Mexico preliminary outline for a State development plan submitted to State Planning Board and National Resources Board. 173 pp., illus. Santa Fe, N. Mex. State Planning Bd., 1934.

This report is the first outline of a State development plan and covers the first six months of work. Information on land use, water resources, mineral resources, transportation, institutions, etc., is dealt with. Treats of the problem of silt control on the Rio Puerco, and gives remedial measures and costs. Considers results of a survey by Bryan and Post who suggest the building of a series of check dams.

DEBSKI, KAZIMIERZ.

1. The movement of detritus in the river bed of the Vistula. Internatl. Geod. and Geophys. Union, Comn. Potamol., Rpt. 7, question 3, 7 pp., 1939. Derives an equation for detritus movement.

DECOVREY, B. W.

1. Improvement of Gray's Harbor, Wash. Amer. Soc. Civ. Engin., Trans., vol. 32, pp. 477-485, illus., Dec. 1894.

Describes improvement of Gray's Harbor, Wash. Includes description of shoaling in harbor with silt and sand, and improvement by system of matted pile jetties and jetty dam to cause scouring of shoal.

DEEDS, J. F.

1. Climatic eccentricities initiate abnormal erosion [letter to editor]. Civ. Engin., vol. 3, no. 5, p. 287, May 1933.

Comments on the article, Influence of Overgrazing on Erosion and Watersheds (Chapman, H. H., 3). Statements in the original article are exaggerated. Instances cited are not representative of average erosion conditions. The changes in the stream habit are due to natural laws, not to overgrazing. Sparse vegetation of regions was noted before the advent of livestock.

DE HORATUS, M. See Horatus, M. de.

DELAPP, WARREN.

1. Sediment behavior in upward flow. Thesis (M. S.) - State Univ. Iowa, June 1940; [abstract], Iowa Univ., Studies in Engin. Bul. 33, p. 57, 1949.

Describes an experimental and analytical study of sediment concentration variations due to upward motion of water through a sediment column. Obtains a generalized relationship between the ratio of fall velocity and flow velocity, the concentration and vertical gradient of piezometric head.

DELLENBAUGH, F. S. See Rich, J. L., 1.

DEMENTIEV, M. A. See Voinovich, P. A., 1.

DEMPSTER, M. G.

1. River bank protection at Stratford, Victoria. Commonwealth Engin., vol. 23, no. 7, pp. 213-216, illus., Feb. 1, 1936.

The bank of the River Avon near Princes Highway East immediately west of township of Stratford, Victoria, Australia, was protected from scour originally (1896) by 1000 ft. of timber-sheet piling which subsequently failed to provide adequate protection. Willow planting, protected by stone-filled willow crib, also failed to give protection. Sheet steel piling was considered, but the final plan involved the use of combination sheet piling footing to support a concrete retaining wall. Construction of the wall is described in detail.

DENT, ELLIOT JOHNSTONE. See also Freeman, J. R., 3; Howard, G. W., 1; Todd, O. J., 10, Whipple, W., Jr., 1.

1. Notes on the mouths of the Mississippi River. New Orleans, U. S. Engin. Off., 1921.
Gives data and information concerned with the mouths of the Mississippi. Treats of sediment carried by the river. Considers mud lumps. Notes the transportation of sand by sand waves.
2. The mouths of the Mississippi River. La. Engin. Soc., Proc., vol. 8, no. 2, pp. 83-99, illus., Apr. 1922.
Deals with conditions of sediment transportation and deposition, jetty construction, and future channel maintenance at the mouths of the Mississippi River. Rate of advance of delta into the Gulf is discussed.
3. The delta of the Mississippi River. Military Engin., vol. 15, no. 79, pp. 11-15, illus., Jan./Feb. 1923.
Discusses the delta of the Mississippi River. Notes changes that have taken place since 1838. Conditions along both the South and Southwest Passes, Pass a l'Outre Crevasse, and the Grand Bayou are described, particularly noting the formation and subsidence of marsh land, the factors causing these occurrences, and the rate of their growth or subsidence. Caving in of banks during the 1920 flood is noted, as is rate of deposition of silt in parts of the delta during the 1922 flood.
4. The mouths of the Mississippi River. Amer. Soc. Civ. Engin., Trans., vol. 87, pp. 997-1006, illus., 1924.
Describes the extent of new areas built up by the sediment load of the Mississippi River at its mouths since 1838; mechanical analysis, method of transportation, and rate of settling of sediment; and effect of fresh-water discharge into salt-water sea.

DENVER, CHERRY CREEK FLOOD COMMISSION.

1. Report, May 1913. 159 pp., illus. Denver, Smith-Brooks Press, 1913.
Describes the Cherry Creek flood of July 14, 1912, and presents details of proposed improvements for flood prevention in the Cherry Creek drainage basin, Colo. Notes that the raised condition of the Cherry Creek bed, just above its mouth, due to the existence of a diversion dam on the South Platte, was a contributing factor to the flood. Includes brief discussion of the probable life of proposed flood-control reservoirs on Cherry Creek.

DEPT. OF AGRICULTURE. See U. S. Dept. of Agriculture.

DEPPA, JAMES W.

1. The formation and control of arroyos in the Southwest. Jour. Forestry, vol. 46, no. 3, pp. 174-179, Mar. 1948.

Discusses the principles of arroyo formation in the Southwest. Describes tested and practical methods of arroyo control. Gives an analysis of a typical arroyo and describes five sectors of an arroyo.

DETMERS, FRED A.

1. A preliminary report on a physiographic study of Buckeye Lake and vicinity. Ohio Jour. Sci., vol. 12, no. 7, pp. 517-532, illus., May 1912.

Discusses the existence or non-existence of Lake Licking, physiographic history of Buckeye Lake, and the location and extent of Newark River valley, Ohio. Notes that all positive and negative evidence precludes the possibility of the existence of Lake Licking. The existing thick stratum of gravel in the region could alone have been carried by flood waters from a glacier and had not been deposited in the quiet waters of a lake. Notes also the lack of lake beaches, lake clays, and sand or stream delta deposits, indicating the non-existence of a lake. Points out extensive deltas built by several small streams entering Buckeye Lake, in one case approximately 200 ft. long.

DE TURK, E. E. See Brown, C. B., 30; Stall, J. B., 1.

DHAWAN, C. L. See Hoon, R. C., 1.

DICKESON, M. W. See Brown, A., 1.

DICKMANN, EMILIO.

1. La construcción de caminos con material aluvional de rios [The construction of roads with river alluvium]. Ingenieria [Buenos Aires], vol. 46, pp. 667-671, illus., Aug. 1942. In Spanish. Translation on file at the U. S. Soil Conservation Service, Washington, D. C.

Describes method of building a highway to Puerto Colastine, Argentina, with material removed from the bottom of the Colastine and Santa Fe Rivers by hydraulic dredging.

DICKSON, A. J. See Harrold, L. L., 2.

DILLMAN, GEORGE L. See Foote, A. D., 2.

DIN, MIRZA MOHAMMED.

1. Behavior of rivers and their training. India. Cent. Bd. Irrig. Jour., vol. 4, no. 4, pp. 326-329, 341, illus., Oct. 1947.

Comments on river control and training. Considers such subjects as bank protection, erosion, scour, and prevention of erosion.

DIX, F. JOHNSON.

1. (and Blair, G. W. Scott). On the flow of suspensions through narrow tubes. Jour. Appl. Phys., vol. 11, no. 9, pp. 574-581, Sept. 1940.

Discusses the anomalous flow of certain suspensions through narrow tubes known as the sigma-phenomena, for which no fully satisfactory explanation has yet been given. Derives formulas depending on the relation assumed to exist between velocity gradient and shearing stress and on the nature of friction between streamlining layers which adequately explain sigma-phenomena.

DIXEY, FRANK.

1. Level variations of Lake Nyassa and sunspot cycles. Pan-Amer. Geol., vol. 48, no. 5, pp. 335-342, illus., Dec. 1927.

Discusses relationship of sunspot cycles to variations in the level of Lake Nyassa, Africa. The chief cause of the silted-up condition of upper Shire River was the steady fall in mean annual level of Lake Nyassa from 1903 to 1914; a contributing factor was the added silt load eroded from hills recently denuded of natural vegetative cover. The result was a tendency to raise the lake level. Changes in regimen of the Shire River on account of rises of Lake Nyassa during rainy periods, 1923-28, are described.

2. A practical handbook of water supply. 571 pp., illus. London, Thomas Murby & Co., 1931.

Suggests cultivation of silted-up reservoirs for rice or other crops, mentioning numerous tanks in southern India used for this purpose. Suggests dam above reservoir, to be cleaned out periodically, and off-channel reservoirs in flats as a means of preventing reservoir silting.

DIXON, H. A. See Blaess, A. F., 1.

DIXON, J. W. See Hathaway, G. A., 1.

DIXON, S. M.

1. Foreign notes. Civ. Engin. and Public Works Rev., vol. 32, p. 394, Nov. 1937.

Discusses a technical article by R. Siefert (V.D.I. Zeitschrift, vol. 81, p. 1161) on model studies for tidal estuaries and the application of models to the design of siphon spillways. Notes a model study on the lower Seine River in connection with silting in the harbor. The use of groynes (training walls) at the entrance to the harbor reduced the rate of silt deposition to 1/3 or 1/4 of the rate of deposition under earlier conditions.

DIKSON, S. M. See Buckley, A. B., 1.

DOANE, THOMAS.

1. River protection at Plattsmouth, Nebr. Van Nostrand's Engin. Mag., vol. 15, pp. 38-40, July 1876.

Describes method of bank protection on the Missouri River at Plattsmouth, Nebr.

DOBBIN, C. E.

1. Sudden floods initiate erosion [letter to editor]. Civ. Engin., vol. 3, no. 6, p. 334, illus., June 1933. Comments on Influence of Overgrazing on Erosion and Watersheds, (Chapman, H. H., 3). Discusses historical growth of arroyos in Chaco Canyon and concludes that climatic phenomena as well as overgrazing may be a cause of erosion.

DOBBINS, H. T.

1. Chaining the Missouri. Sci. Amer., vol. 121, no. 13, pp. 306, 322, illus., Sept. 27, 1919.

Describes the use of the Bignell reinforced concrete pile in bank reclamation work on the Missouri River. The immediate effect of these retards is to induce sedimentation.

DOBBINS, WILLIAM E.

1. Effect of turbulence on sedimentation. Amer. Soc. Civ. Engin., Trans., vol. 109, pp. 629-656, illus., 1945; also in Amer. Soc. Civ. Engin., Proc., vol. 69, no. 2, pp. 235-262, Feb. 1943.

Presents results of studies attempting to extend the basic theory of turbulent flow which has been used to explain the observed vertical distribution of suspended matter being in equilibrium with the bed material. The paper presents results in an effort to explain the concentration changes in a stream or settling basin under nonequilibrium conditions. Derives the general differentiated equation expressing the concentration changes during turbulent sedimentation in an infinitely wide stream; presents the complete solution for a simplified case.

Discussion: A. M. GAUDIN, p. 657, hopes that subsequent papers should include the problem of distribution of particles in a flowing stream and systems in which particles of various sizes, shapes, and specific gravities occur simultaneously. JOHN S. MCNOWN, pp. 657-660, comments on the definition and application of proper boundary conditions and parameter variations, and presents some equations bearing on the problem. Discusses the measurement of settling velocity of particles and the indirect determination of turbulence parameters. HANS ALBERT EINSTEIN, p. 660, treats effects of increase in turbulence on shortening settling time of sediment in settling basins. Comments on the exchange of particles between bed and suspension, noting that this exchange may some day be used in calculating rates of bed material carried in suspension without measurements of concentration.

THOMAS R. CAMP, pp. 660-666, points out that the paper shows that suspended sediment is not held in suspension in a turbulent stream, but is settling and being continuously thrown into the stream by scour. Considers suspended-load distribution and concentration of suspended load which depends on scour. Gives equations relating to effects of turbulence and settling. GARBIS H. KEULEGAN, pp. 667-669, examines the statement of the boundary conditions relating to the solution of the differential equation of the one-dimensional case. C. W. THORNTHWAITTE, pp. 669-671, comments on studies of measuring the transport of moisture from a natural surface into the atmosphere, using the medium of turbulent mass exchange. Treats Vanoni's experiments which show that the suspension of sediment in water will tend to make

it more stable, and that velocity of sediment-laden water is greater than clear water. Comments on the need to modify Prandtl's theory of turbulence before applying it to sediment transport in streams. A. A. KALINSKE, pp. 672-674, considers the author's conclusions relating to the influence of bed composition on suspended material. Comments on the "pick up" from the bed and the relation between suspended and bed material, and gives equations pertaining to this problem. E. R. VAN DRIEST, pp. 674-676, points out that he is not in accord with the derivation of one of the equations. Notes that the author simplified the boundary conditions at the cylinder bottom by requiring constant hydraulic conditions at the bed.

R. SCHUHMAN, p. 676, notes the treatment of the effect of turbulence on sedimentation was the simplest possible turbulent sedimentation system; because of complicating effects of variable particle size, concentrated suspension, flocculation, etc., empirical data are acquired in practicable sedimentation systems. Shows interest in the observations on pick-up. H. B. SOUTHWOOD, pp. 676-677, comments on the paper, noting that relations may be established whereby turbulence may be measured by sediment observations. Treats the factors which contributed to existence of observed concentration in excess of plotted theoretical values. L. STANDISH HALL, pp. 677-678, considers the application of tests and theory developed in the paper for use for sediment studies of natural streams. THE AUTHOR, p. 678, points out that the principal difficulties in the solution of the problem are in obtaining the solution to the general form of the differential equation and in obtaining the complete relationship between the rate of pick-up from the bottom and controlling factors.

DOBSON, A. D.

1. On the destruction of land by shingle-bearing rivers, and suggestions for protection and prevention. New Zeal. Inst. Trans. and Proc., vol. 4, pp. 153-157, 1871.

Describes conditions of erosion and the transportation and deposition of erosional detritus by streams in New Zealand. The effects of forest destruction upon conditions of stream flow and detritus transportation are considered. Proposed methods for the prevention of land destruction by streams are discussed.

2. On the reclamation of waste river beds. New Zeal. Inst. Trans. and Proc., vol. 14, pp. 100-103, 1881.

Describes a proposed scheme for the reclamation by planting of barren shingle beds of streams in New Zealand. The effect of the utilization of shingle beds upon the regulation of the rivers so planted is discussed.

DOBSON, GILBERT C. See also Broughton, W. A., 1; Du Boys, M. P., 1; Eakin, H. M., 8; Grover, N. C., 12; Happ, S. C., 2, 3, 5, 6; Johnson, J. W., 8; MacClintock, P., 1.

1. A formula for capacities of reservoirs. Soil Conserv., vol. 1, no. 7, pp. 7-9, illus., Feb. 1936.

Describes formula developed specifically for computing original capacity, present capacity, and silt volumes in storage reservoirs. Formula uses data obtained in reservoir surveys by the Section of Sedimentation Studies, U. S. Soil Conservation Service to derive volumes with the maximum of accuracy which such data allow.

2. Relation of sedimentation studies to a flood-control program. Soil Conserv., vol. 3, no. 8, pp. 219-222, 234, illus., Feb. 1938.

A paper on the relation of sedimentation studies to a flood-control program. Gives summarized estimates of life spans of existing reservoirs in the United States from Rates of Silting in Representative Reservoirs Throughout the United States (Brown, C. B., 5) and notes that programs for conservation should include as a major aim, the preservation of the effectiveness and the extension of the life span of reservoirs. Discusses the use of reservoir storage as a flood-control measure. Notes the parallel nature of a flood-control program and aims to

prevent damage by silting to downstream flood control works. Determination of damages by silting, a function of Section of Sedimentation Studies of the U. S. Soil Conservation Service, is a prerequisite to determine priority of treatment areas in a major watershed. Discusses objectives of sedimentation studies and describes briefly interrelated projects to accomplish these aims.

3. (and Johnson, Joe W.). Studying sediment loads in natural streams. *Civ. Engin.*, vol. 10, no. 2, pp. 93-96, illus., Feb. 1940.
Describes the technique of making bed-load observations used by the U. S. Soil Conservation Service at the Enoree River Laboratory, S. C. Summarizes briefly other phases of the research program carried on by the Sedimentation Division. Studies on the Enoree River involve observations on the relations between sediment load and the hydraulic and physical characteristics of a stream, velocity and suspended-load observations, and bed-load sampling. Describes new type of control and procedure to accurately measure total sediment load of a stream. Gives details of control structure, and method of measuring suspended load. Describes samplers and other supplementary observational equipment. Summary chart of factors observed at Enoree River Laboratory during February 1939 is given.
4. A revision in the instructions for computing reservoir sedimentation surveys made by the contour method. *U. S. Soil Conserv. Serv., Sedimentation Div., Tech. Let. Sed-16*, 4 pp., Jan. 24, 1941.
Presents a revision for that part of the instructions for reservoir sedimentation surveys applying to the computation of surveys made by the contour method, which appears under the heading Computation of Original Capacity and Sediment Volume, in *U. S. Dept. Agr. Tech. Bul. 524, Silting of Reservoirs* (original edition 1936, p. 136, revised edition, 1939, p. 162) and in *Tech. Let. Sed-8*, p. 14.
5. (and Einstein, H. A.). The unexpected rejuvenation of George Creek. *Soil Conserv.*, vol. 8, no. 1, pp. 12-13, 32, July 1942.
Describes a complete cycle of sedimentation, within the time of men now living, of George Creek, a small tributary of the Saluda River in South Carolina. Notes the possible cause of rejuvenation to be construction of a dam or the installation of sand pumps on the stream.

DOGE, B. H.

1. Design and operation of debris basins. *Inter-Agency Sedimentation Conf., Proc.*, 1947, pp. 274-294, illus., 1948.
Describes the use of debris basins in the Los Angeles area by the U. S. Corps of Engineers, in cooperation with the Los Angeles County Flood Control District. Construction, capacity, costs, use, etc., of debris basins are given. Notes damages by debris flow in the vicinity of Los Angeles, such as in the La Crescenta area. Average debris production rates for debris basins in the area are given.
Discussion: H. C. STOREY, p. 294, points out the influence of fire in increasing erosion rates. Shows also the table representing annual average rates of debris production in a number of debris basins is not indicative of a long-time normal rate. W. J. PARSONS, JR., pp. 295-298, summarizes the criteria used in the location and design of the debris basins in the Sacramento District. The various problems encountered are noted, including the problem of mining debris. The debris basins of the Sacramento District are compared to those of the Los Angeles District. J. H. DOUMA, pp. 298-301, defines several terms and comments on the design and operation of debris dams.

DOGE, RICHARD E.

1. Arroyo formation [abstract]. *N. Y. Acad. Sci., Ann.*, vol. 15, no. 1, p. 50, Aug. 31, 1933.
Discusses processes of arroyo formation and rates of valley filling and erosion.

DOUGLAS, D. J.

1. The importance of heavy mineral analysis for

regional sedimentary petrology. *Natl. Res. Council, Div. Geol. and Geog., Com. Sedimentation, Rpt.* (1939-40), pp. 102-121, illus., Dec. 1940.

Discusses various methods of study of heavy minerals and comments on the use of heavy-mineral analysis for determining the origin, and geographical and stratigraphical distribution of samples. Considers the interpretation of heavy mineral work and gives various conclusions.

2. Interpretation of the results of mechanical analyses. *Jour. Sedimentary Petrology*, vol. 16, no. 1, pp. 19-40, Apr. 1946.

Describes the method of interpretation of results of mechanical analyses of deposits by use of arithmetic probability paper which enables a study of phenomena caused by differentiation of the transported detritus. Mechanical analyses were made with a new type of sedimentation balance, which is described.

DOHM, C. F. See also Twenhofel, W. H., 6.

1. Petrography of two Mississippi sub-deltas. *La. Geol. Survey, Geol. Bul.* 8, pp. 339-402, illus., Nov. 1, 1936.

Discusses the petrography of two sub-deltas of the Mississippi River. Deals with such subjects as collection of samples, mechanical analyses, mineral analyses, and results of analyses.

DOKE, H. G. See Du Boys, M. P., 1.

DOLE, RICHARD B.

1. (and Westbrook, F. F.). The quality of surface waters in Minnesota. *U. S. Geol. Survey, Water-Supply Paper* 193, 171 pp., illus., 1907.
Deals with the quality of stream waters of Minnesota. Data are given on turbidity, and dissolved and suspended loads of surface waters of the upper Mississippi, Minnesota, St. Croix, Zumbro, St. Louis, Red, and Rainy River basins (1903-05). Methods of analyses are described.
2. (and Stabler, H.). Denudation. *U. S. Geol. Survey, Water-Supply Paper* 234, pp. 78-93, 1909; also in *Natl. Conserv. Comm., Rpt.*, 60th Cong., 2nd sess., S. Doc. 676, vol. 2, pp. 126-140, illus., 1909; [abstract], *Amer. Geog. Soc. Bul.*, vol. 42, no. 10, pp. 780-781, 1910.
Presents tabulated data on estimated rates of denudation for the whole United States and for primary drainage basins, from various sources. Tabulations include amount of dissolved and suspended mineral matter transported by streams, size of areas tributary to streams, and stream discharges. Discusses the sources of data and methods and accuracy of computations, and summarizes results of calculated data.
3. The quality of surface water in the United States. *U. S. Geol. Survey, Water-Supply Paper* 236, pp. 5-119, 1909.
Deals with investigations of the quality of surface waters in the United States. Outlines the methods employed in the analyses of waters, collection of samples, and determinations of turbidity, total suspended solids, and total dissolved solids. Minor departures from regular procedures in the analyses of waters of the Mississippi and Androscooggin Rivers and the waters of Southeastern States are discussed. Discusses probable accuracy of estimates considering theoretical limits of accuracy, methods of checking, methods of computing probable accuracy, relation between total solids and percentage of error, and the relation between source and amount of water and percentage of error. Criteria for rejecting analytical data and method of expressing analytical results are given. Presents tabulated results of analyses of certain rivers and lakes east of the 100th meridian.
4. The quality of surface waters in Mississippi River basin. III. *Water Supply Assoc., Proc.* 2, pp. 64-80, illus., 1910.
Presents results of a study by the U. S. Geological Survey on the mineral constituents of surface waters in relation to rock composition and other factors that affect them in the Mississippi River basin. Average amounts of suspended and dissolved solids in certain tributaries of the Mississippi River are given to illustrate the

different amounts of mineral matter carried. The climatic and geologic conditions affecting the quality of the waters are considered. Changes in the mineral content of Mississippi River water at various stations are given and discussed. Considers the relations between suspended and dissolved solids and gage height for rivers in the Mississippi Valley. The industrial importance of the relation between the quality of surface and underground waters is discussed, and an example of how economic developments can affect this relationship is given.

5. The mineral constituents of the waters of rivers in the Mississippi basin. *Ill. Soc. Engin. and Surveyors, Ann. Rpt.* 25, pp. 214-219, Jan. 1910.
Presents results of suspended- and dissolved-load determinations of river waters in the Mississippi River basin. Discusses factors affecting the load of streams, variations in mineral content, relation between quality of surface and of underground water in a drainage basin, and the value of such studies to municipalities seeking water supplies and to water-consuming industries.
6. Chemical character of the waters of southwestern Ohio. *U. S. Geol. Survey, Water-Supply Paper* 259, pp. 172-217, 1912.
Deals with the mineral content of underground and surface waters of southwestern Ohio. Presents data on turbidity and dissolved- and suspended-load determination of waters of the Miami River at Dayton (September 1906-September 1907), on suspended and dissolved solids in the Ohio River at Cincinnati (1898), and miscellaneous analyses of surface waters in southwestern Ohio.
7. Chemical character of waters of the coastal plain of Georgia. *U. S. Geol. Survey, Water-Supply Paper* 341, pp. 470-537, illus., 1915.
Presents results of analyses of waters of the coastal plain of Georgia. Data are given on turbidity and dissolved- and solids-load determinations (October 1906-October 1907) for waters of the Chattahoochee, Ocmulgee, Savannah, Oostanaula, Flint, and Oconee Rivers. Comparison of average mineral content of the six streams with that of certain other surface waters of the United States is made.
8. Chemical character of the waters of northeastern Arkansas. *U. S. Geol. Survey, Water-Supply Paper* 399, pp. 281-309, illus., 1916.
Presents results of the mineral analyses of waters of northeastern Arkansas. Includes data on turbidity and dissolved- and suspended-load determinations of waters from Arkansas River near Little Rock, Cimarron River at Englewood, Verdigris River at Coffeyville, and Neosho River at Oswego (1906-07), and from Mississippi River at Memphis; Tenn. (1907-08).
9. (and Chambers, Alfred A.). Chemical character of some surface waters of Alaska. *U. S. Geol. Survey, Water-Supply Paper* 418, pp. 99-109, 1917.
A paper presenting results of dissolved- and solids-load determinations of some surface waters of Alaska. Data are given on general character of the surface waters and on comparative composition of the waters with that of other large North American rivers.

DONALD, M. B.

1. Sedimentation and flocculation. *Chem. & Indus.*, vol. 59, no. 7, pp. 105-109, Feb. 17, 1940; also in *Engineering*, pp. 248-249, Mar. 8, 1940.
Briefly summarizes available data on the effects of flocculation upon the rate of settling of solids.

DONAT, JOSEF.

1. Ueber Sohlangriff und Geschiebetrieb (Bed attack and bed-load transport). *Wasserwirtschaft*, no. 26-27, 1929. In German. Translation on file at U. S. Soil Conservation Service, Washington, D. C.
A critical analysis of bed scour and bed-load transport problems.

DONNELLY, MAURICE. See Sharpe, C. F. S., 3.

DOOLITTLE, H. L.

1. Design of sand box for Kern River hydro-electric plant. *Engin. News-Rec.*, vol. 88, no. 15, pp. 616-617, illus., Apr. 13, 1922.

Describes design of sand box installed at Kern River No. 3 Hydro-Electric Plant, Calif., to remove sand from river water and thus avoid damages to turbines.

DORR, J. V. N.

1. (and Roberts, E. J.). Sedimentation - the velocity of fall of individual spheres in liquids. *Amer. Inst. Chem. Engin., Trans.*, vol. 33, 1937, pp. 106-144, tables, graphs, 1938.
Presents data which support the average curve of Castleman. Gives an equation for calculating the accurate settling velocities of spheres over a range of Reynolds numbers of 1 to 10.

DORSEY, EDWARD BATES.

1. Irrigation. *Amer. Soc. Civ. Engin., Trans.*, vol. 16, pp. 85-102, 1887.
Discusses various phases of irrigation as practiced in the United States and foreign countries. Includes four paragraphs noting conditions of canal design to prevent scouring and silting, fertilizing value of silt, and the problem of silting in large canals used for both irrigation and navigation purposes.
Discussion: A. D. FOOTE, pp. 103-108, outlines briefly the fertilizing value of silt of the rivers of western United States and of the rivers of Italy and France.

DOSCH, EARL F. See Thornthwaite, C. W., 1.

DOTY, P. M.

1. (and Mark, H.). Size and shape of macromolecules in solution; methods of measurement. *Indus. and Engin. Chem.*, vol. 38, pp. 682-686, illus., July 1946.
Considers indirect methods of determining the size of polymer molecules with the idea that they may be used for the determination of particle size of other substances where ordinary methods are not applicable or corroboration is needed. Discusses methods based on ultracentrifuge, osmotic pressure, light scattering, and streaming birefringence.

DOUGLAS, L. E.

1. Curves for irrigation-ditch velocity and discharge. *Engin. News*, vol. 76, no. 2, pp. 72-73, illus., July 13, 1916.
Treats the determining of curves for velocities and discharges using Kutter's formula. Notes limits of velocities in ditches in the United States, where soil is mostly sandy loam, as 1.5 ft. per sec. to prevent deposition of silt and excessive erosion.

DOUMA, J. H. See Dodge, B. H., 1.

DOWD, M. J.

1. Why the All-American Canal. *Commonwealth Club Calif., Trans.*, vol. 21, no. 2, pp. 75-80, Apr. 13, 1926.
An address dealing briefly with the flood and silt problems of the Imperial Valley and discussing the prospects of the proposed All-American Canal in the alleviation of the water-shortage problem of the Valley.
2. How the Imperial Irrigation District meets its problem of silt deposition and erosion. *Engin. & Contract.*, vol. 69, no. 12, pp. 436-438, illus., Dec. 1930.
Describes methods employed in the Imperial Irrigation District which secure practical solutions to the problems of erosion and silt deposition. Notes the specific problems of accelerated erosion, silting of canals and ditches, building up of land with fertile silt deposits, and adequate drainage. The engineering installations in the Imperial Valley, Calif., which solve these problems, are described.
3. Silt problems of Imperial Irrigation District as affected by completion of Boulder Dam. *Civ. Engin.*, vol. 9, no. 10, pp. 609-611, illus., Oct. 1939.
Discusses the changes in the silt conditions of the Imperial Irrigation District which have thus far been brought by the completion of Boulder Dam. The lowered silt content of the District's water supply resulted in the discontinuance of dredging operations at the diversion point and in the reduction of costly maintenance operations in canals, laterals and drainage ditches. Coincident with the reduction in silt content, the problems of increased seepage and growth

of vegetation and moss in canals and laterals have arisen. The rate of delta expansion of the New and Alamo Rivers which carry the drainage and waste waters of Imperial Valley has been materially reduced. Completion of the All-American Canal and the desilting works at its head will further alter the silt conditions in the irrigation district.

DOWNES, STANCLIFF B.

1. Improvement of the Wisconsin and Fox Rivers. School Mines Quart., vol. 4, no. 1, pp. 30-41, illus., Nov. 1882.

Describes methods employed for the improvement of the Wisconsin and Fox Rivers and the effects of the improvements. Notes briefly the character of sand bars or sand waves in the Wisconsin River; states that improvement works for 8 miles below Portage have reduced its width about one-third, increased the average depth on bars by 9 in., and reduced the number and length of bars.

DREVESKRACHT, L. R. See also Hellman, N. N., 2.

1. (and Thiel, G. A.). Ionic effects on the rate of settling of fine-grained sediments. Amer. Jour. Sci., vol. 239, no. 10, pp. 689-700, illus., Oct. 1941.

A study regarding the ionic effects of the settling rates of 10 fine-grained sedimentary materials suspended in solutions of potassium chloride, sodium chloride, magnesium chloride, and distilled water. Explains variations in settling velocity on basis of size, uniformity and shape among different materials in the same suspension medium. States mineral composition has little effect on rate of coagulation. Gives results of experiments.

DRISKO, JOHN B.

1. Model research in the River Hydraulic Laboratory of the Massachusetts Institute of Technology. Amer. Geophys. Union, Trans. 13, pp. 384-387, illus., 1932.

Pertains to hydraulic model studies at the Massachusetts Institute of Technology during 1929. Describes model studies on the transportation of sand by running water and on bank erosion and protection on the Connecticut River.

2. Improving the Oder River. Civ. Engin., vol. 3, no. 6, pp. 314-318, illus., June 1933.

Describes the history of improvements to the Oder River and its tributaries in Germany which have benefitted navigation and agriculture, and have retarded recurrent floods. Comments on the adverse effects of canalization upon the regimen of the stream, protective work, open river regulation by means of groins, treatment of entering tributaries to prevent deposits at their mouths, river improvement at bends, and the cut-off at Reinberg.

DRIVER, W. J.

1. Flood control and soil erosion. Ark. State Planning Conf., Proc., 1934, pp. 80-86.

Discusses the need for adequate planning with reference to flood and erosion control in Arkansas. Briefly notes conditions of sand transportation and deposition in the Arkansas River.

D'ROHAN, W.

1. The silting up of reservoirs and canals and some methods for preventing same. Engin. & Contract., vol. 35, no. 2, pp. 56-58, illus., Jan. 11, 1911.

Discusses problem of the silting of reservoirs and canals and describes methods proposed to prevent such silting. Notes that surveys of 1895 and 1905 on La Grange Reservoir, Tuolumne River, Calif., showed a loss of 54.2 percent of the storage capacity in 10 yr., 1 mo. due to silting. Austin Reservoir on the Colorado River, Tex., built in 1893, lost 41.54 percent of its original capacity in 4 yr. Describes various arrangements for sluicing deposited silt from reservoirs and different devices to prevent silt from entering canals and reservoirs. Notes that the most effective method of excluding silt from a reservoir is by the use of silt traps, sand boxes, or sedimentation basins.

DROUHET, FELIX.

1. Carriage of alluvium by water courses [extract]. Engin. & Contract., vol. 49, no. 22, pp. 522-525, May 29, 1918.

An extract from a technical paper by L. W. Collet in collaboration with Messrs. Mellet and Stumpf (Annales Suisses d'Hydrographie) discussing determination of and influences on sediment transported by streams. An example of suspended load determination in the Rhone River is given. Prevention of silting up of storage reservoirs is described. Gives equations on time required for silting up of reservoirs and lakes, and data on sediment in European waters.

DRYDEN, CLARISSA. See Dryden, L., 5.

DRYDEN, HUGH L.

1. Recent developments of the theory of turbulence. Jour. Appl. Mechanics, vol. 4, no. 3, pp. A105-A108, Sept. 1937.

Presented at a joint meeting of the Hydraulic and Applied Mechanics Division of the American Society of Mechanical Engineers, Cornell University, Ithaca, N. Y., June 25-26, 1937. Gives a brief account of the principal concepts which were utilized in the formulation of theories of the turbulent motion of fluids prior to 1935, and discusses the new approach originated by G. I. Taylor in 1935. Includes a bibliography of 31 papers.

DRYDEN, LINCOLN.

1. Cumulative curves and histograms. Amer. Jour. Sci., (ser. 5), vol. 27, no. 158, pp. 146-147, Feb. 1934.

Believes the conclusions of E. Wayne Galliher are in error in an article entitled Cumulative Curves and Histogram (Galliher, E. W., 1). Discusses the errors made by Mr. Galliher on setting forth the advantages of the cumulative curves over histograms.

2. A statistical method for the comparison of heavy mineral suites. Amer. Jour. Sci., (ser. 5), vol. 29, no. 173, pp. 393-408, illus., May 1935.

Introduces a numerical method for the comparison of heavy mineral suites. Discusses the term "correlation." Considers the statistical correlation of heavy mineral suites. Notes use of the coefficient of determination as a number to take the place of a word or words to compare two samples by their heavy mineral frequencies.

3. [Review of] The graphical representation of heavy mineral analyses, by P. Evans, R. J. Hayman, and M. A. Majeed. Jour. Sedimentary Petrology, vol. 6, no. 1, pp. 48-49, Apr. 1936.

Comments on a paper (Reprint no. 29, World Petrol. Congress, London, 1933) concerned with the graphical representation of heavy-mineral analyses. Notes that the paper discusses methods of securing mineral frequencies, and the method used in the graphical representation of heavy-mineral analyses.

4. [Review of] Eine Methode zur exakten Sedimentationsmessung, by Niels Nielsen. Jour. Sedimentary Petrology, vol. 6, no. 2, pp. 119-120, Aug. 1936.

The original paper appears in Danske Vidensk. Selsk., Biol. Meddel., vol. 12, no. 4, pp. 1-98, 1935. Describes a method of coloring sand grains in order to study their movements in the Skalling Peninsula, Denmark. Considers modified use of method to estimate amount of new sediment deposits brought in and spread over marshes of Skalling during spring floods; observations show annual increment of about 3-4 mm.

5. (and Dryden, Clarissa). Comparative rates of weathering of some common heavy minerals. Jour. Sedimentary Petrology, vol. 16, no. 3, pp. 91-96, Dec. 1946.

States that when heavy minerals are liberated from the parent rock, the more resistant species have a heavy concentration and the less resistant species decrease in abundance. Changes in abundance of various minerals from fresh rock to weathered products is a measure of resistance of weathering. Considers the Wissahickon schist from Pennsylvania and

Maryland; zircon is the most resistant and garnet the most readily destroyed in weathering. Notes applications of the method used to other geological fields and soil science.

DRYER, CHARLES R.

1. The meanders of the Muscatatuck at Vernon, Indiana. Ind. Acad. Sci. Proc., 1898, pp. 270-273, illus., 1899.

Describes development and conditions of meandering of the Muscatatuck River at Vernon, Ind. Notes that small alluvial deposits at the tips of present lands enclosed by meanders indicate that lateral cutting has not entirely ceased.

2. Some features of delta formation. Ind. Acad. Sci. Proc., 1909, pp. 255-271, illus., 1910.

Describes some features of delta formation along shores of the Finger Lakes, N. Y. Deltas formed along the shores of Hemlock Lake, N. Y. at mouths of gullies during the storm of July 1909. Describes conditions of deposit and characteristic features of deltas. Notes occurrences of notched deltas and fans at Mill Creek (Honeoye Lake) and at Canadice outlet (Hemlock Lake).

3. (and Davis, Melvin K.). The work done by Normal Brook in thirteen years. Ind. Acad. Sci., Proc. 1910, pp. 147-152, illus., 1911.

Describes some of the features and changes to Normal Brook, three miles east of Terra Haute, Ind., 1897-1910. Conditions of scour and deposition are noted.

DU BOYS, M. P.

1. Etude du regime du Rhone et de l'action exercée par les eaux sur un lit a fond de graviers indéfiniment affouillable (Study of the regime of the Rhone and the action exercised by the waters on an indefinitely shifting bed of gravel). Ann. des Ponts et Chaussées, (ser. 5), vol. 18, pp. 141-195, 1879. In French. Translation by H. G. Doke, Assistant Engineer, U. S. Engineer Office, Memphis, Tenn., 1933 (55 pp.) on file at the U. S. Soil Conservation Service, Washington, D. C., and the U. S. Engineer Office, Memphis, Tenn.

Dealing with the translation by H. G. Doke, the article is a study of the Rhone River and the problem of improving crossings and includes the study of laws of transportation of gravel by flowing water. Gives principles of alignment, control of channel form, and views on the interrelations of current velocity and movements of different sizes and quantities of debris. Gives Du Boys' equation for tractive force, and various other formulas. Notes an expression of the force of entrainment. Considers various important concepts concerning the problem.

Discussion: G. C. DOBSON, (Appendix (26 pp.) to the translation), makes various comments on the mathematical developments put forth by Du Boys. HANS KRAMER appends an extract (7 pp.) from Sand Mixtures and Sand Movement in Fluvial Models, commenting on Du Boys' equation for tractive force and Du Boys' hypothesis of bed-load movement.

DUCE, JAMES TERRY.

1. The effect of cattle on the erosion of cañon bottoms. Science n. s., vol. 47, no. 1219, pp. 450-452, May 10, 1918.

Outlines the effect of cattle on the erosion of the arid cañon country in southeastern and southwestern Colorado. Describes the formation and growth of arroyos.

DUFOUR, HENRI.

1. Automatic eliminators for alluvial matter in water-turbine supplies. Engineering, vol. 120, pp. 247-249, 313-316, 379-381, illus., Aug. 28-Sept. 25, 1925.

Presents observations relative to the loss in output of several hydroelectric plants in Europe due to the wearing effect of silt on water turbines. Describes some modern installations for the automatic elimination of alluvial matter from hydroelectric plants for the protection of water turbines. Presents some results obtained in practice with automatic eliminators for alluvial matter in water-turbine supplies. The determination of the limit of efficiency desirable in an eliminator is briefly considered.

DUGMORE, G. E.

1. Sluits - their evil and prevention. Cape of Good Hope, Dept. Agr., Agr. Jour., vol. 26, no. 3, pp. 375-380, illus., Mar. 1905.

Describes the progress of sluicing in the Indwe and Lady Frere portions of the Cape of Good Hope. Evil effects and measures for the prevention of sluicing are discussed. Describes use of vegetative barriers to arrest growth of sluits, to induce silt deposition, and to prevent silt from entering into reservoirs. The effort of the Indwe Co. to cause the Doorne River channel to silt up by damming the river is briefly described.

DULEY, F. L.

1. (and Miller, M. F.). Erosion and surface runoff under different soil conditions. Mo. Agr. Expt. Sta., Res. Bul. 63, 47 pp., illus., Dec. 1923.

Describes and gives results of experiments dealing with the accurate determination of runoff and soil erosion under varying conditions of soil, crops, and tillage. Discusses results of observations by various investigators on water-soluble material and sediment carried by various streams, indicating the extent of land-surface reduction in the various watersheds and stressing in particular the loss of important nutrient elements from the soil because of erosion.

DUNBAR, WILLIAM.

1. Description of the River Mississippi and its Delta, with that of adjacent parts of Louisiana. Richmond Enquirer, vol. 1, no. 25, p. 2, Aug. 1, 1804.

Points out that during the time of flood the Mississippi River is muddy not solely because of the effect of the Missouri River but also because of bank caving. Discusses the development of cut-offs and the formation of islands.

DUNCANSON, H. B.

1. Observations on the shifting of the channel of the Missouri River since 1883. Science n. s., vol. 29, no. 752, pp. 869-871, illus., May 28, 1909.

An article relative to observations on the shifting of the channel of the Missouri River in a portion of the river valley near Peru, Nebr. since 1883. Describes conditions of bank erosion and deposition, noting that the river is methodical in its shiftings. Predeterminations may be made of location of new channel and new deposit. Channel cuts western bluffs almost regularly but does not invade upon eastern bluffs. Effect of earth's rotation on bank cutting along the Missouri River is mentioned.

DUNHAM, H. F. See Babb, C. C., 1; Freeman, J. R., 3; Sonderegger, A. L., 1.

DUNKLEE, D. E.

1. (and Midgley, A. R.). The effect of 1936 flood deposits on Vermont farm lands. Vt. Agr. Expt. Sta. Bul. 445, 16 pp., illus., Mar. 1939.

Reports results of observations and reclamation studies continued over a period of three years on farm lands of Vermont which were affected by the deposition of silt and debris resulting from the floods of March 1936. Presents data on type, character, extent, and depth of river deposits; extent of river-bank and soil erosion; flood damages; fertility of deposited material; tolerance of plants to siltation; and methods for the reclamation of a vast acreage of sterile silt and sand.

DUNN, E. J., JR.

1. Microscopic measurements for the determination of particle size of pigments and powders. Indus. and Engin. Chem., Analyt. Ed., vol. 2, no. 1, pp. 59-62, illus., Jan. 15, 1930.

Describes a method of particle-sizing for particles from colloidal dimensions up to sieve dimensions. Particle images are projected through a microscope upon a screen, where they are classified and measured. Notes that the micro-projection method of particle-sizing is probably the most accurate method available for obtaining the true size of particles in a fine pigment or powder.

2. (and Shaw, John). Factors in the presentation and comparison of particle size data. Amer. Soc. Testing Mater., Proc., vol. 33, pt. 2, pp. 692-703, illus., 1933.

DUNN, E. J., JR. - Continued

Considers certain important factors affecting the comparison and presentation of particle-size data. Discusses briefly some problems of measurement. Summarizes various graphical forms of presenting data. Describes the present status and use of representative functions of particle-size data. Emphasizes the need for the standardization of methods of particle-size analysis and presentation of data.

DUNN, H. H.

1. Teaching the Mississippi to brush its own teeth. *Pop. Mechanics Mag.*, vol. 32, no. 1, pp. 8-12, illus., July 1919.

Describes means devised to keep the mouth of the Mississippi clean of mud, sand, and silt. The method consists of contracting the channel inside jetties and directing the main current through the contracted channel. Spur dikes are employed along the main jetties to catch silt and build up artificial land.

DURAND, WILLIAM F.

1. The problem of the Colorado River. *Mech. Engin.*, vol. 47, no. 2, pp. 79-84, illus., Feb. 1925.

Deals with the flood, irrigation, water-supply and power-development problems of the lower Colorado River. Notes need for measures to reduce the amount of silt transported by the stream. Briefly considers the problem of silt accumulation in the proposed reservoir at Boulder Canyon.

DUREPAIRE, M. P. See Howard, G. W., 1.

DURHAM, WILLIAM.

1. Suspension of clay in water. *Chem. News*, vol. 30, no. 767, p. 57, Aug. 7, 1874.
Experiments on the effects of additions of varying quantities of acid or salt upon the rate of settling of clay particles in water are described.

DUSHANE, J. D.

1. Hydraulic dredges and dredging on the improvement of the upper Mississippi River. *Prof. Mem.*, vol. 4, no. 17, pp. 723-739, illus., Sept./Oct. 1912.

An article on hydraulic dredges and dredging for the improvement of the upper Mississippi River. Notes that the river carries little silt but is a sand rolling stream, that much sand is brought in by larger tributaries during floods, and that bank erosion adds much sand to the channel annually. Describes the formation of shoals, and discusses in detail purposes and methods of dredging.

DU TOIT, P. J.

1. Irrigation in the Karroo. Cape of Good Hope, Dept. Agr., *Agr. Jour.*, vol. 26, no. 1, pp. 62-68, Jan. 1905.

Describes the effectiveness of various types of irrigation practices undertaken in the Karroo, Cape of Good Hope. Includes one paragraph describing works at Tondelboschkolk where periodic deposits of silt on irrigated lands maintain the fertility of the soil.

DUTTON, CLARENCE E.

1. Tertiary history of the Grand Cañon district. *U. S. Geol. Survey, Mono.* 2, 264 pp., 1882.

Describes the Tertiary history of the Grand Cañon district. Includes discussions on the excavation of the Grand Cañon; processes of corrasion and weathering; G. K. Gilbert on the subject of corrasion; nature and extent of the water supply of the Colorado; origin, extent, and character of the sediment load of the stream; the declivity of the river; the nature of corrasive and weathering actions; and the scouring action of sand.

2. Report. *U. S. Geol. Survey, Ann. Rpt.* (1888-89) 10, pt. 2, pp. 78-108, 1890.

Outlines the progress of the irrigation survey on the lower Rio Grande. Includes seven paragraphs describing results of experiments conducted to determine the most convenient methods of sampling silt and drying filtrates.

DWIGHT, TIMOTHY.

1. A statistical account of the City of New Haven. 66 pp., illus. New Haven, 1811. (Reprint from New Haven City Year Book, 1874).

Discusses silting up of harbor at New Haven, Conn. Where foreign vessels formerly docked, there are now gardens. Mentions dike built across meadow, on the West River, in 1769, to reclaim land.

EADS, JAMES B.

1. Action of under-currents in the Mississippi [extract]. *Franklin Inst. Jour.*, vol. 86, no. 4, pp. 244-248, Oct. 1868.

From report on conditions of the Mississippi River bed at sites of foundations for the proposed Illinois and St. Louis Bridge. Discusses observations on conditions of bed scour and deposit, action of undercurrents in causing bed movement, and effect of ice gorges in producing increased currents below gorge which result in excessive scour.

2. Alluvial basin of the Mississippi River. *Sci. Amer. Sup.*, vol. 1, no. 11, pp. 162-164, illus., Mar. 11, 1876.

A discussion of the Mississippi River flood-control plan of the U. S. Commission of Engineers. Notes plan is contrary to natural laws governing sediment-bearing rivers. Discusses in detail and calls erroneous Commission's claims that increased river volume will permanently raise flood line, that cut-offs will permanently raise flood line below them, that Mississippi is always undercharged with sediment, that no relation exists between current velocity and quantity of sediment suspended, and that crevasses do not cause deposits below them. Disagrees with conclusions of Commission on composition of river bed and its resistance to erosion.

3. Improvement of the Mississippi [extract]. *Sci. Amer. Sup.*, vol. 5, no. 116, pp. 1839-1840, Mar. 23, 1878.

An extract from address delivered at the Cotton Exchange, New Orleans, on the protection of alluvial lands of the Mississippi River and improvements to the stream between St. Louis and the Gulf. Discusses controversy between Captain Eads and U. S. Engineer Corps with reference to the improvement to the mouth of the Mississippi River. Outlines theory of stream velocity as a function of slope and bed friction, noting conditions of erosion, and transportation and deposition of sediment. Advocates channel contraction works to confine channel to a uniform width and the closure of outlets and island chutes in order to protect the alluvial lands of the Mississippi.

4. The hydrology of the Mississippi River. *Van Nostrand's Engin. Mag.* vol. 19, pp. 211-229, illus., Sept. 1878.

This critical review of the Report upon the Physics and Hydraulics of the Mississippi River (Humphreys, A. A., 1) points out that many of the statements are not supported by facts. Discusses the problem of the relation between the current and suspended sediment.

5. Hydrology of the Mississippi. *Van Nostrand's Engin. Mag.*, vol. 21, no. 2, pp. 154-158, Aug. 1879.

A reply to The Physics of the Mississippi River (Abbot, H. L., 2). Notes that the writer is charged by Gen. Abbot with making reckless misstatements in a review of Humphreys and Abbot's Report on the Physics and Hydraulics of the Mississippi River (Humphreys, A. A., 1).

6. Improvement of the Mississippi River, and the Tehuantepec ship railway [abstract]. *Sci. Amer. Sup.*, vol. 12, no. 305, pp. 4859-4860, Nov. 5, 1881.

An abstract of address before the British Association at York on the improvement of the Mississippi River and the proposed Tehuantepec ship railway. Notes failures of early plans for the improvement of the Mississippi due to its discharge and the enormous quantities of sediment transported. Criticizes assumption of Humphreys and Abbot relative to the relationship between quantity of material transported and velocity of stream. Describes jetty plan of improvement based on theory that chief element resisting flow of current is friction of stream bed. States that accelerating velocity due to jetties would increase capacity of stream, enabling it to carry sediment out to sea. Describes use of wire screens on the Missouri River to induce silt deposits, build up banks, and contract channel. Discusses need for a ship railway across the American Isthmus.

7. Improvement of the Mississippi [abstract]. *Engin. News*, vol. 9, p. 139, Apr. 29, 1882.

An abstract of the minority report of the Mississippi River Commission, dissenting from a

majority report recommending the construction of a sill to interrupt communication between the Mississippi and Atchafalaya Rivers, and from proposed improvements of Vicksburg Harbor. The minority report advocates closing gaps in the Mississippi River levees. Process of sedimentation in river channel and on flood plain is described, as is also effect of closing gaps in levees on increasing river flow, the scouring of river bed, and the lowering of the flood level.

EAKIN, HENRY M. See also Fuller, G. L., 1; Poor, R. S., 1; Red Cross, U. S. National Red Cross. Board of Engineers, 2.

1. Influence of the earth's rotation on the lateral erosion of streams. *Science*, n. s., vol. 31, no. 791, pp. 319-320, Feb. 25, 1910.

Notes that observations on Alaska rivers indicate a high efficiency of deflective force resulting from earth's rotation, which affects lateral erosion of streams.

2. The influence of the earth's rotation upon the lateral erosion of streams. *Jour. Geol.*, vol. 18, no. 5, pp. 435-447, illus., July/Aug. 1910.

Discusses the influence of the earth's rotation upon the lateral erosion of streams with particular reference to streams in the higher latitudes. Reviews briefly the principles which give rise to this deflecting force and shows that the influence of the earth's rotation is to unbalance the lateral erosion of streams and that the deflective force has greater strength in the higher latitudes.

3. Harmful effects of erosional waste. U. S. Soil Erosion Serv., Land, Today and Tomorrow, vol. 1, no. 2, pp. 4-7, illus., Nov. 1934.

Describes the effects of accelerated erosion resulting in the transportation of erosional debris by streams, progressive stream shoaling, increased flood intensities, sedimentation of flood plains, and silting of reservoirs. Briefly discusses rates of silting in representative reservoirs of the southern Piedmont region, Black Land regions of Texas, semi-arid Southwest, and California.

4. Reservoir silting results from preventable erosion, survey shows [abstract]. *Soil Conserv.*, vol. 1, no. 3, pp. 6-7, 14, illus., 1935.

A report of progress on reservoir surveys and investigations of the U. S. Soil Conservation Service. Discusses objectives and methods of surveys made. The direct purpose of each survey has been to determine the volume and distribution of sediment deposits accumulated in a reservoir during a known period of time. Gives a table showing depletion of storage capacity due to silting in representative reservoirs of the Southeast, South Central, and Southwest. In the Southeast, reservoir silting is related chiefly to erosion of deep residual soils as influenced by human occupation (agricultural methods); notes need for erosion control practices. In the Southwest, silting of reservoirs is largely a result of overgrazing and its subsequent sheet and gully erosion; notes need for engineering and vegetative preventative methods. Describes a method of selective mud evacuation above dams to preclude the possibility of reservoirs silting up.

5. Diversity of current-direction and load distribution on stream-bends. *Amer. Geophys. Union, Trans.*, vol. 16, pt. 2, pp. 467-472, illus., Apr. 1935.

Deals with the behavior of currents and load distribution at stream bends. Discusses theory of "helical flow" and hydraulic laboratory practices of J. Thompson, M. F. DuBoys, and others. Describes studies on current behavior and related movement and distribution of sediment in the Mississippi River at Tamm Bend near Dyersburg and Merriwether Bend near Tiptonville, Tenn., including examination of surface slope, distribution of direction and velocity of flow, direction of bottom currents, suspended sediment observations, and bank caving. Shows that systematic divergency of current direction at stream bends is indicated by superelevation of waters toward outer bank of bends. Experimental data indicate the existence of systematic cross-section components

of motion. The observation of sediment distribution authenticates theory and results.

6. The twin problem of erosion and flood-control. *Amer. Geophys. Union, Trans.*, vol. 17, pt. 2, pp. 436-439, 1936.

Treats of the relationship of erosion and flood control to changes in geologic norms effected by human agencies. Discusses alterations in the output of water and sediment from upland areas, caused by accelerated erosion, resulting in increased rate and volume of run-off and increased quantity of debris. Effects of increased water and sediment output on aggradation in stream channel, flood-level changes, and flood control are discussed. Data are given for incoming and outgoing sediment loads and percentage of load deposited in the Mississippi River alluvial region below Cairo, Ill. The amount of aggradation in the over-bank area of the valley is described. Discusses conditions of levee-freeboard reduction due to loss of over-area, noting conditions of overbank deposit; changes in channel area, and rise of flood-flow line. Notes importance of down-valley trends of stream, and valley adjustment to accelerated headwater-erosion.

7. Meeting the menace of overflow waters. *Soil Conserv.*, vol. 1, no. 6, pp. 5-6, Jan. 1936.

Discusses comprehensive flood control by confinement and guidance of river waters, control of erosion, and transportation and redistribution of sediment; influence of upland erosion, noting need for control; use of headwater reservoirs to reduce flood discharge, noting possibility of filling with sediment; effect of levees on sedimentation; effect of revetment or bank protection on stream load and flowage; use of floodways and subsequent deposition of sediment; channel contraction; and effect of cut-offs on flood levels, sedimentation, and bank caving.

8. Instructions for reservoir sedimentation surveys revised January 1, 1936 by G. C. Dobson and Carl B. Brown. U. S. Soil Conserv. Serv. SCS-SS-2, 36 pp., Jan. 1, 1936.

Gives instructions for reservoir sedimentation surveys. Treats such items as plan of survey, choice of reservoirs, choice of survey methods, contour method, range method, computations, note keeping, survey monuments, and preparation of reports.

9. Silting of reservoirs. U. S. Dept. of Agr., *Tech. Bul.* 524, 141 pp., illus., July 1936. Rev. by Carl B. Brown (168 pp.) Aug., 1939.

A discussion of the economic and physical aspects of the reservoir-silting problem and processes of reservoir silting. Reviews previous silting investigations made on 16 basin-type reservoirs in the United States including 5 re-surveyed by the U. S. Soil Conservation Service in 1935-36. Presents silting data on 15 reservoirs of channel or small capacity-inflow ratio type. Describes the field work, methods of survey and results of detailed silt surveys made by the Soil Conservation Service, 1934-38, on 67 different reservoirs in southeastern, south-central and southwestern United States. Discusses reconnaissance investigations of reservoirs in southeastern, southern Appalachian Mountain, south-central, and Pacific Southwest regions of the United States. Includes a table listing 15 completely silted reservoirs in the Piedmont region. Presents an appendix which includes instructions for reservoir sedimentation surveys.

10. The influence of deforestation upon stream and valley resources. *Jour. Forestry*, vol. 34, no. 11, pp. 983-987, Nov. 1936.

Reports studies of the factors and physical laws governing the interrelations between deforestation, accelerated erosion, and stream and valley readjustments to changed water and sediment supply. Comments on rates of percolation, volume and rapidity of runoff, and floods with relation to changes in water output due to deforestation. Points out the changes in sediment loads transported by surface waters as a result of accelerated erosion and summarizes readjustments of stream and valley phe-

nomena as a result of deforestation. Indicates the effect on soil fertility of overwash deposits in valleys of the Piedmont region. Disserts on down-valley trends of progressive stream and valley readjustments to headwater erosion. Notes the need for control measures and describes sedimentation and hydraulic studies of the U. S. Soil Conservation Service regarding fundamental problems.

EARDLEY, A. J.

1. Yukon channel shifting. *Geol. Soc. Amer. Bul.*, vol. 49, no. 3, pp. 343-358, illus., Mar. 1, 1938.

Presents an analysis of results of a study to determine the mechanism involved, the extent and rate of activity of the process of channel shifting in the Yukon Valley, and the conditions of erosion and deposition. The origin and characteristics of sloughs are discussed.

EARGLE, D. HOYE.

1. Advance report on the sedimentation survey of Lake Harris, Tuscaloosa, Alabama. U. S. Soil Conserv. Serv., SCS-SS-4, 7 pp., illus., May 5, 1936.

The survey, Oct. 30-Nov. 6, 1935, revealed that Lake Harris, a municipal water-supply reservoir located on Yellow Creek, eight miles northeast of Tuscaloosa, Ala., had lost 1.97 percent of its original capacity from silting since completion in February 1929. The original capacity of the reservoir was 2421 acre-feet and in 6.75 yrs. of operation 47.7 acre-feet of sediment accumulated in the reservoir, an average annual loss of 0.292 percent. Of the 30 sq. miles of watershed area, 85 percent is forested, 5 percent is pasture and idle land, and 10 percent is farmed. Sediment in the reservoir is derived chiefly from sheet and gully erosion on steeper slopes and interstream areas, stream bank erosion, and corrosion on the stream beds. Detailed information on the origin, character, distribution, and volume of sediment in the reservoir is included, and the engineering features of the dam and reservoir are described.

2. Advance report on the sedimentation survey of Lake Purdy, Birmingham, Alabama. U. S. Soil Conserv. Serv., SCS-SS-5, 11 pp., illus., July 1936.

The survey, Nov. 6-28, 1935, disclosed that Lake Purdy, an auxiliary storage reservoir for the water supply of Birmingham, located on the Little Cahaba River, 8.8 miles southwest of Birmingham, had lost 2.55 percent of its original capacity in 25.2 yrs. due to silting. The original storage capacity of the reservoir, at crest stage, was 19,080 acre-feet and, in 25.2 yrs. of operation, 486 acre-feet of sediment accumulated in the reservoir, and average annual loss of 19.29 acre-feet. Sediment in the reservoir is derived chiefly from soil erosion on steeper slopes and sheet erosion in broad gently rolling valley areas. Of the 41.74 sq. miles of watershed area, 70 percent is forested, 15 percent is open pasture land, and 15 percent is cultivated; the forest cover is an important factor in decreasing the rate of sedimentation of the lake. Detailed information relative to the engineering features of the dam and reservoir, character of watershed, and the distribution, character, and volume of sediment in the reservoir, is included.

3. Advance report on the sedimentation survey of High Rock Reservoir, Salisbury, North Carolina. U. S. Soil Conserv. Serv., SCS-SS-10, 23 pp., illus., Feb. 1937.

The survey, conducted from May 18 to Oct. 25, 1935 at High Rock Reservoir, a power development located on the Yadkin River, 14 miles southeast of Salisbury, N. C., revealed that the reservoir had lost 4.81 percent of its original capacity since its completion in November 1927, the average annual loss in capacity amounting to 0.62 percent. The total capacity of 289,432 acre-feet was reduced by 13,916 acre-feet during 7.8 yrs. of operation. The report includes data on the engineering aspects of the dam and reservoir, character of the watershed, conditions of erosion on the watershed, inflow into reservoir, floods and flood damages in the Yadkin watershed, and character, distribution,

and origin of the sediment in the reservoir. Results of the survey indicate a correlation between character, amount, and distribution of sediment in the tributary arms of the reservoir and the texture and erodibility of the soil on the contributing watershed, also between land use and the extent of reservoir silting.

4. Advance report on the sedimentation survey of Bayview Reservoir, Birmingham, Alabama. U. S. Soil Conserv. Serv., SCS-SS-11, 12 pp., illus., Mar. 1937.

During Nov. 1935-Jan. 1936, a sedimentation survey was made of Bayview Reservoir, an industrial water-supply reservoir located on Village Creek, 4 miles northwest of Birmingham, Ala. The reservoir, when completed in May 1911, had an original storage capacity of 11,866 acre-feet. In 24.6 yrs., 2,352 acre-feet of sediment had accumulated causing a reduction in capacity of the reservoir equal to 19.82 percent of the original capacity at an average rate of 0.81 percent per year. The watershed comprises 72.3 sq. miles, of which 50 percent is urban development, 25 percent forests, and the balance cultivated land and pasture. The sediment is derived chiefly from sheet, rill, and gully erosion and to some extent from refuse dumps of several large coal mines in the watershed. An analysis of the sediment showed it to contain 7.49 percent volatile matter. Detailed information is included on the character, volume, distribution, and origin of sediment in the reservoir and on engineering data relative to the dam and reservoir.

5. The relations of soils and surface in the South Carolina Piedmont. *Science*, n. s., vol. 91, no. 2362, pp. 337-338, Apr. 5, 1940.

Studies of physiographic factors of soil erosion in the South Carolina Piedmont, the Climatic and Physiographic Division of the Soil Conservation Service. Notes that the lateral movement of soil ranks with the vertical movement within its profile and acts as an agent of the genesis of soil, soil characteristics, and soil distribution. Minor land forms of the region, important in soil formation, are due to physiographic processes of mass-movement.

EATON, E. COURTLANDT.

1. Flood and erosion control problems and their solution. *Amer. Soc. Civ. Engin., Trans.*, vol. 101, pp. 1302-1330, illus., 1936.

Describes physical conditions and methods of solving problems of flood and erosion in Los Angeles County, Calif. Describes conditions of flood flow in the area giving data on historic floods, rainfall and runoff; engineering methods of constructing hydrographs of expected floods; methods of flood control; and conditions of the flow of debris. Discusses data on the effect of vegetative cover on rates of erosion; measurements of quantities of erosion from burned areas; debris floods; computed quantities of deposits in Haines and Verduga debris basins and on property and streets; and debris control. Conservation of flood waters from domestic and irrigation purposes resulting from flood regulation is discussed.

Discussion: E. I. KOTOK and C. J. KRAEBEL, pp. 1330-1345, notes the value of natural cover of vegetation as a protection from floods and debris flows, and describes studies in watershed management by the California Forest and Range Experiment Station, U. S. Forest Service. Discusses the 1934 flood flow from Pickens Canyon, noting conditions of scour and the difficulty in measuring debris-laden stream flows; and the success of a critical-depth flume developed by the Experiment Station. Data are presented on erosion rates and runoff from burned and chaparral watersheds in southern California. HARRY F. BLANEY, pp. 1337-1340, points out the physical aspects of debris flows in southern California. A survey by the writer and C. A. Taylor, entitled *Damage Resulting from Movements of Debris Out of Canyons During the Storm of December 30, 1933 to January 1, 1934*, in Southern California, an unpublished report, is noted as giving data on the moisture content of soil in movement as mud-

flow. Notes that the proper method of measuring discharge under conditions existing in southern California canyons is to gauge the rate of rise in the debris basin at the canyon mouth. Mention is made of the function of brush cover in controlling runoff, the effects of denudation by fire on increased mudflow, and the control of floods and moving masses of detritus by barrier systems. Describes briefly results of experiments by the U. S. Bureau of Agricultural Engineering on water-spreading and rates of percolation at the mouth of San Gabriel Canyon (1930-32). W. P. ROWE, pp. 1340-1344, takes exception to the accuracy of Eaton's statements relative to quantities of material eroded from mountain sides in southern California, and to the relative effect of denudation by fires and mudflows. Agrees with Eaton's statement with reference to the effectiveness of the Haines Canyons debris basin; and describes conditions of filling and readjustment of bed, banks, and grade in contradistinction to Eaton's views on the filling of the basin. J. B. LIPPINCOTT, pp. 1344-1350, describes plans and operation of the Los Angeles County Flood Control District and the physical conditions of stream drainage basins conducive to floods and mudflows. Discusses efforts to solve problems by the construction of dams, debris basins, channel improvement, and spreading basins to prevent flood damage and to conserve water. Notes beneficial effects of brush and forest cover in reducing floods and erosion and discusses costs. THE AUTHOR, pp. 1359-1362, makes comments on various facts brought out and includes additional information on flood and debris control.

EATON, FREDERICK M. See Van Winkle, W., 1.
EATON, HERBERT N.

1. The National Research Council Interdivisional Committee on Density Currents. Amer. Geophys. Union, Trans., vol. 18, pp. 520-522, 1937.

Notes field and laboratory work of various agencies to determine the conditions of occurrence of density currents in reservoirs. Suggests the possible use of currents to force the deposit of the entire load of sediment in the reservoir or to pass a large portion of it through outlet gates. Notes also the possible correlation of the phenomenon of underflow with other studies.

2. Progress-report of the National Research Council Interdivisional Committee on Density Currents. Amer. Geophys. Union, Trans., vol. 19, pp. 387-392, illus., 1938.

Presents available data on the occurrence of density currents at the bottom of Elephant Butte Reservoir and of Lake Mead. Investigations of inflow and outflow conditions at Elephant Butte, made by the International Boundary Commission and the U. S. Bureau of Reclamation, respectively, show a record of at least one flow of silty waters as bottom-current in each odd-numbered year since 1917, with the exceptions of 1925 and 1937. The latter exception is believed due to the small peakflows of the Rio Puerco in that year. The electrometric method is used for the determination of total dissolved solids in the inflow; volume and temperature of discharge, elevation of surface of the reservoir, and temperature of surface-water are measured daily. Monthly determinations of water-temperatures in verticals and midway between the intake-towers at Boulder Dam and at mid-channel at Cape Horn, and similar observations at Boulder Canyon and Virgin Canyon have made it possible to locate the top of the layer of muddy water and the elevation of the bed. Laboratory work of the U. S. Geological Survey on the composition of water and on concentration of dissolved salts is mentioned, and analytical data for the samples from the Boulder Dam project are tabulated. Results of determinations of the concentration and chemical composition of water in various parts of Lake Mead and at different depths show that concentration increases with depth; and results obtained at Grand Canyon show changes in composition which indicate movement of density-currents

through the lake. Elevations of the top of silty water and the bed for the pool upstream from the cofferdam are given; the question as to how the silty water passed the cofferdam is discussed. Evidence that silty water overflows the cofferdam owing to a rise in the level of its upper surface is presented. During Mar. 1-9, the level of silty water increased 52 ft., or 11 ft. higher than the crest of the cofferdam. Experimental studies made by the National Bureau of Standards on the flow of stratified liquids are mentioned. A criterion developed by B. H. Munish and G. H. Keulegan is presented, for mixing when the mean velocity of the current but not its velocity-profile is known.

3. Report of the Interdivisional Committee on Density Currents. Natl. Res. Council, Div. Geol. and Geog., Ann. Rpt. 1938-39, App. H, 6 pp., illus., Dec. 1939.

Presents results of observations on the flow of silt-laden waters through Elephant Butte, Lake Mead, and Norris reservoirs. Monthly loads of suspended matter in the Colorado River at Grand Canyon (Bright Angel) for May, June, July and September 1938 are given.

EBERT, F. C. See McGlashan, H. D., 1.

EBNER, GEORGE.

1. Operator's viewpoint of canal and structure design. Engin. News-Rec., vol. 89, no. 26, pp. 1116-1117, Dec. 28, 1922.

Gives irrigation canal operator's observations on location of structures, silt problem, design to prevent or minimize slides, methods of handling weeds and alkali, and preferences as to chutes, pipes or drops. Silt is prevented from entering canals by raising the diversion weir and canal intake, resulting in a backwater pond upstream where creek sediment can be unloaded. Use of a shallow canal section is advised to prevent bank slides. In maintenance work, the construction of grade control and drops is found more economical than continual silt cleaning.

2. Experience in cleaning irrigation ditches by machine. Engin. News-Rec., vol. 107, no. 5, p. 172, July 30, 1931.

Describes the machine used on the Valier Irrigation Project, Mont., mode of operation, cost, and effectiveness. Notes that the necessity for canal maintenance is not due to sediment carried by water in canals but is brought about by the deposition of wind-blown earth from summer-fallowed fields. Notes work attached to cleaning irrigation canals of the Imperial Valley, in which silt is deposited from irrigation waters (Engin. News-Rec., vol. 105, no. 13, p. 501, Sept. 25, 1930).

EDELMAN, C. H.

1. Petrology of recent sands of the Rhine and the Meuse in the Netherlands. Jour. Sedimentary Petrology, vol. 8, no. 2, pp. 59-66, illus., Aug. 1938.

Presents data on the mineralogy of Rhine and Meuse sands in the Netherlands. Give detrital mineral associations of the sands for the two rivers.

EDEN, EDWIN W., JR. See also Lane, E. W., 15.

1. A study of bed movement and hydraulic roughness changes in the lower Mississippi River. 84 pp. June 1938. Unpublished thesis, State University of Iowa; [abstract], Iowa Univ., Studies in Engin., Bul. 19, p. 60, May 1939.

Reviews the available literature on the movement of sand waves in natural rivers. Describes mainly observations on the Mississippi River at Lake Providence, Carrollton, and Helena in 1879 and 1880. Presents in detail observations on the elevations of the bed of the Mississippi River at the bridges at Memphis and Vicksburg which were computed by the U. S. Geological Survey. Gives data which show the formation of distinct sand waves; the formation of these waves did not seem to affect the mean hydraulic roughness of the channel.

EDGEcombe, A. R. B.

1. Report on the silting of reservoirs and measures taken or projected for its prevention or control. 36 pp. illus., tables and graphs. Allahabad, Supt. Printing and Stationery, United Provinces, India, 1934.

Deals with information obtained from the U. S. Bureau of Reclamation concerning silting of reservoirs at the Elephant Butte Dam on the Rio Grande River in New Mexico, the McMillan Dam on the Pecos River in Texas, and the Roosevelt Dam on the Salt River in Arizona. Report summarizes methods for dealing with silt. Prevention and removal of silt from reservoirs are considered. Takes up the method of sluicing by under sluices and crest gates.

EDHOLM, CHARLES L.

1. Tapping the Colorado. *Cement World*, vol. 6, no. 9, pp. 32-37, illus., Dec. 1912.

Describes construction of the Laguna Dam, Yuma Irrigation Project, Ariz., and features of the design of works which will exclude silt from the Yuma Canal.

EDMINSTER, FRANK C.

1. Wildlife management through soil conservation on farms in the Northeast. U. S. Dept. Agr., *Farmers' Bul.* 1868, 52 pp., illus., Feb. 1941.

Considers some of the possible ways of checking erosion and increasing wildlife in the 12 Northeastern States. Methods of planting stream banks to keep sediment from streams and of caring for water areas and swamps to prevent silting are described.

EDMONDSON, CHARLES H.

1. Shellfish resources of the northwest coast of the United States. U. S. Bur. Fisheries, *Ann. Rpt.*, App. 3, 21 pp., illus., 1922.

Reports a survey during the summers of 1917-19 for the purpose of surveying the shellfish resources of the northwest coast of the United States. Notes effect of silt deposition, resulting from rains of December 1917 and January 1918, upon the development of clams in the Siuslaw River and tributaries, Oreg. Work to keep sediment from smothering oysters in the Yaquina River, Oreg., in 1917 is briefly described.

EDMUNDS, CHARLES K.

1. Taming the Yellow River. *Military Engin.*, vol. 13, no. 69, pp. 336-338, illus., May/June 1921.

Describes the plan of John R. Freeman for the control of the Yellow River, involving the narrowing and straightening of the present channel to increase the velocity of the stream and cause it to dig its own channel deep to the sea.

EDWARDS, A. D.

1. Dredging at Muscle Shoals Canal with ladder dredge. *Military Engin.*, vol. 4, no. 13, pp. 51-54, illus., Jan. 1912.

Describes deposition of sediment and formation of bars opposite mouths of streams entering the canal. Includes detailed description of bucyrus dredge used in cleaning the canal. Notes operation and construction costs of dredge. Table shows yardage dredged and cost.

EDWARDS, A. M.

1. Silting of O'Shaughnessy Reservoir. *Civ. Engin.*, vol. 6, no. 8, pp. 511-512, Aug. 1936; [abstract], *Pub. Works*, vol. 67, no. 9, pp. 35-36, Sept. 1936.

Presents methods and results of a silt survey conducted on the O'Shaughnessy Reservoir, Scioto River, Ohio, under the supervision of C. E. Sherman, in December 1934. Silt exposed by low water could be walked on and have test holes dug in it to determine its depth. Underwater silt was surveyed by a sounding reel of the U. S. Geological Survey type, with steel rod or wooden disk attached to end of the tape for original channel elevation and silt surfaced elevation measurements, respectively. Reservoir silted 1,016 acre-feet, out of 16,673 acre-feet original capacity, in nine years, or at the rate of 0.7 percent per year, amounting to 6.1 percent of capacity. Specific gravity of silt is 2.66. It would cost five times as much per 1,000,000 gal. of storage to remove silt as to build equivalent new storage capacity.

EDWARDS, FRANK W. See also Vogel, H. D., 8.

1. Model study of sediment removal at Gays Mills hydro-electric plant, Wisconsin. 54 pp. June 1930. Unpublished thesis (M. S.) - State University of Iowa; [abstract], *Iowa Univ., Studies in Engin.*, Bul. 19, p. 56, May 1939.

Describes tests conducted on 1:40 scale model to determine method for removing silt deposited in forebay of a low head hydro-electric installation during a flood period when head of dam was negligible. Determines comparative velocities required to pick up and carry materials in suspension by using flume tests on model sediment and natural sediment. The model sediment was a concrete admixture of finely-ground, meta-colloidal, tripoli silica. The removal of the sediment was secured by installing a gate immediately upstream from the power house and constructing a connecting channel to the tail-race.

EDWARDS, WM.

1. On dry warping at Hatfield Chase. *Roy. Agr. Soc. England, Jour.*, vol. 11, pp. 180-183, 1850.

Discusses "dry warping" or improvement of land by use of deposited sediment in contrast to usual procedure of "warping" with muddy water. An area of 4,000 acres in Yorkshire, England, "dry warped" with alluvial material which remained when the tidal river Thorne, or Idle, changed its course 200 yrs. before. Describes method used to secure and distribute sediment, and discusses results obtained. Cost of improvement given.

EGBERT, N. See Parshall, R. L., 2.

EGIAZAROFF, J. B. See Vogel, H. D., 8.

EGOLF, C. B.

1. (and McCabe, W. L.). Rate of sedimentation of flocculated particles. *Amer. Inst. Chem. Engin., Trans.*, vol. 33, 1937, pp. 620-640, illus., tables, graphs, 1938.

Studies the sedimentation of flocculated particles using five different materials. Proposed a method of reconstructing curves by dividing the process into an initial straight line, or free settling period, and the final or compression period. Suggests correlations for the initial rate and compression period. Attempts to develop a formulation which, when given the initial height and concentration of a suspension of flocculated particles, and the viscosity of the medium, will allow the prediction of the height of the suspension at any subsequent time.

EGUIAZAROV, I. V.

1. Experimental investigation of the head and inlet structures of hydroelectric plants on silt-carrying rivers, and the investigations of the hydro-electric laboratory for Dzoraghies, Adjaris-Zhali and Kanakir Hydroelectric Plants. *Sci. Res. Inst. Hydraulics, Trans.*, vol. 9, pp. 80-116, illus., 1933. In Russian with English abstract. Translation on file at the U. S. Soil Conservation Service, Washington, D. C.

Gives the silt problems facing an engineer in designing head and inlet structures. Notes methods used in experiments on silt movement by the Hydroelectric Laboratory for Dzoraghies, Adjaris-Zhali, and Kanakir Hydroelectric Plants. Discusses the use of model experiments and results.

EHLE, BOYD.

1. Later achievements of engineers on the lower Susquehanna - harnessing the river. *Cornell Civ. Engin.*, vol. 37, no. 4, pp. 97-99, 120, illus., Jan. 1929.

Describes recent hydroelectric power developments in the lower Susquehanna River. Notes effects of silting up of pool and of the blocking up of draft tube outlet by flood and rock debris upon the operation of the Delta Electric Power plant at Gotridge Falls.

EHRENBERG, M.

1. Observations upon the important part which microscopic organisms play in the choking up of the harbors of Wismar and Pillan; also in the formation of the mud which is deposited in the bed of the Elbe, at Cuxhaven, and upon the agency of similar phenomena in the formation of the bed of the Nile, at Dongola, in Nubia, and in the Delta of Egypt [abstract]. *Edinb. New Phil. Jour.*, vol. 45, pp. 386-388, Apr./Oct. 1841.

A paper read before the Berlin Academy of Sciences, Mar. 1841, stating that the phenomena of sediment deposition in harbors and streams and the fertility of mud deposits results from the effects of the rapid action of microscopic animal organisms.

1. Direkte Geschiebemeasurements an der Donau bei Wein und deren bisherige ergebnisse (Direct detritus measurements in the Danube and their results until now). Wasserwirtschaft, no. 34, 1931. In German. Translation on file at the U. S. Soil Conservation Service, Washington, D. C., and the University of Minnesota, Minneapolis, Minn.
Describes detritus-catching apparatus used by the author on the Danube. Gives the method of taking measurements. Puts forth the idea that detritus-drive in the separate verticals is not an even one, but represents an oscillation process. Affirms the detritus-drive law by Schoklitsch. Gives a summary of the results.
 2. Geschiebemeasurements an Flüssen mittels Auffanggeräten und Modellversuche mit Letzteren (Detritus measurements in rivers by means of gripping instruments and model experiments with the latter). Wasserwirtschaft, nos. 33 & 36, illus., 1932. In German. Translation from University of Minnesota on file at the U. S. Soil Conservation Service, Washington, D. C.
Describes various types of bed-load samplers used in various parts of Europe, including one built by the author. Describes quantitative and qualitative model experiments on bed-load samplers and presents results.
 3. Modellversuche mit Auffanggeräten (Model experiments with gripping instruments). Wasserwirtschaft, no. 5, 1933. In German. Translation on file at the U. S. Soil Conservation Service, Washington, D. C.
Treats of the measurement of bed load of streams. Gives results of measurements on the Danube in 1930-31. Describes bed-load sampling apparatus. Discusses model experiments on bed load. Various results are given.
- EHRGOTT, HERBERT W. See Nichols, K. D., 1.
EIFFERT, C. H. See Taylor T. U., 6.
EINSTEIN, HANS ALBERT. See also American Society of Civil Engineers, 2; Dobbins, W. E., 1; Dobson, G. C., 5; Fairbank, L. C., Jr., 1; Johnson, J. W., 8; Kalinske, A. A., 7; Meyer-Peter, E., 1; Vanoni, V. A., 5; Wilson, W. E., 1.
1. Die Eichung des in Rhein verwendeten Geschiebefangens (Calibrating the bed-load trap as used in the Rhine). Schweiz. Bauzeitung, vol. 110, no. 14, Oct. 2, 1937. In German. Translation on file at the U. S. Soil Conservation Service, Washington, D. C., at California Institute of Technology, Pasadena, Calif., and at the U. S. Waterways Experiment Station, Vicksburg, Miss.
Comments on calibrating bed-load traps used in the Rhine. Discusses bed-load movement. Measurement with traps will give an idea of the characteristics of bed-load movement in rivers, mainly in regard to its temporal course.
 2. (and Anderson, Alvin G., and Johnson, Joe W.). A distinction between bed-load and suspended load in natural streams. Amer. Geophys. Union Trans., vol. 21, pt. 2, pp. 628-633, illus., July 1940.
Discusses the distinction between bed-load and suspended load in natural streams, based on observations by the U. S. Soil Conservation Service at the sediment-load laboratory on the Enoree River near Greenville, S. C. Describes sampling procedures to determine the total sediment-load of a stream. Data are given on average composition of bed material on various ranges of the Enoree River, on the average vertical distribution of various particle sizes in suspension in the stream, and on the discharge and solids-load of the river during the flood of Aug. 17-19, 1939. Defines "bed-load" as that part of total sediment load composed of all particles greater than a limiting size (42-mesh sieve for Enoree River), whether moving on bed or in suspension, at a rate of transportation that seems to be a function of discharge, and including all bed-material in movement; "wash-load" is that part of total sediment load composed of all particles finer than the limiting size, which is usually washed through the reach under consideration without deposition and bears no relation to discharge.
 3. The viscosity of highly concentrated underflows and its influence on mixing. Amer. Geophys. Union, Trans., vol. 22, pt. 3, pp. 597-603, illus., 1941.
Deals with one phase of the problem of density currents, namely, underflows of high clay concentration. Describes a comparatively simple method for measuring the viscosity of clay suspensions. Results of measurements by this method of the effects upon a suspension of varying degrees of concentration and flocculation are given and discussed; application of the results to the behavior of underflows of water with high clay concentration, through reservoirs, is made.
4. Formulas for the transportation of bed load. Amer. Soc. Civ. Engin., Trans., vol. 107, pp. 561-577, illus., 1942; also in Amer. Soc. Civ. Engin., Proc., vol. 67, no. 3, pp. 351-367, illus., Mar. 1941.
Presents a method for the representation of bed-load data based on the conception that bed-load movement is the movement of bed particles as governed by the laws of probability. Results of previous studies describing the movement of bed-load particles by means of statistical methods are used to coordinate the rate of movement with fluctuations of water velocities near the bed. A law of transportation of the bed-load in channels of uniform sediment is derived and is applied to results of experiments with sand mixtures conducted at the U. S. Waterways Experiment Station.
Discussion: JOE W. JOHNSON, pp. 578-580, notes the work of the U. S. Soil Conservation Service in the collection and computation of various published and re-published data on the transportation of bed load in laboratory flumes. The writer's objections to the experimental apparatus and procedure are given and discussed. A. A. KALINSKE, pp. 580-583, questions certain ambiguities and some indefinite statements presented by Einstein relative to the definition of bed load and the concept of critical tractive force. Comments upon the four axiomatic statements on which Einstein bases all his analyses. O. G. HAYWOOD, JR., pp. 583-590, takes up Einstein's observations on model studies regarding the elimination of side-wall influence, and notes that there exists a substantial agreement with his own method, especially for values of bed tractive force. SAMUEL SHULITS, pp. 590-591, comments briefly on the utility of the different formulas for bed-load movement derived by various investigators. Notes the difference between the Schoklitsch formula and the Einstein law with particular reference to the concept of critical tractive force. JOHN S. MCNOWN, pp. 591-594, notes that Einstein omitted some factors of probable importance in his equation for bed-load movement. Discusses Einstein's assumption relative to the existence of a constant ratio between the length of step and the size of particle. THE AUTHOR, pp. 594-597, answers the most important questions raised in the discussions of his paper by Shulits, McNown and Kalinske, particularly concerning the applicability of formulas describing bed-load transportation and the influence of turbulence in bed-load transportation.
 5. Flow on a movable bed. Iowa Univ. Studies in Engin., Bul. 27, pp. 332-341, illus., 1943.
A report presented at the Second Hydraulics Conference which deals with measurements made of rates of bed-load transportation on a mutual stream by means of a portable measuring device to determine the relationship between discharge and rate of bed-load transportation. Presents the development of a general formula for bed friction in terms of rate of transportation as well as one for the expression of the roughness of bed, which indicates the ability of the bed to convert mechanical energy into turbulence. Shows that a universal relationship can be established between the apparent roughness of the stream and the bed-load movement. The value of the method lies in the planning of soil-conservation and flood-control programs when the whole watershed is considered, and in providing a way of tracing sediment down a stream and locating zones where sediment damage may occur. Notes field measurements of rates of bed-load transportation at Mountain Creek, Greenville, S. C., in order to test the applicability of the formula.

6. Controlling sand movement in small streams. S. C. Agr. Expt. Sta., Ann. Rpt., 1941-42, pp. 33-35, illus., Feb. 1943.
Points out sedimentation studies concerned with the prevention of swamping and the reclaiming of bottom lands already swamped. The swamps are caused by the inability of a stream to transport the sediment that comes down from the uplands. Notes that conservation measures will reduce the amount of sediment, but this takes several years; for immediate effects, the transporting ability of a stream can be improved by removing periodically all the trash from the stream channel. Points out, as shown by studies on Mountain Creek, that streams with smooth grass banks, other conditions being unchanged, will move on the average almost three times as much sand as streams with caved-in banks and grown over with trees and shrubs. Gives a table showing the influence of bank cover and slope upon the transportation of sand by Mountain Creek.
7. Bed-load transportation in Mountain Creek. U. S. Soil Conserv. Serv., SCS-TP-55, 50 pp., illus., Aug. 1944.
Presents the results of experiments on sediment transportation in Mountain Creek which is a typical small stream of the southern Piedmont in South Carolina. Develops methods of estimating the bed load of a small stream, methods of estimating the effects of reducing sediment loads through conservation practices in small valleys, and methods for estimating the effects of channel improvements on sedimentation in channels and flooding.
8. Sediment movement in Wildwood Canyon. U. S. Soil Conserv. Serv., Off. Res., TR-75-CF-Ri, 29 pp., illus., June 1945.
A sediment study conducted as a basis for a plan to prevent further flood and sediment damage and to open up some land for agriculture in a stretch of the Wildwood Canyon, south of Yucaipa, Calif., by channelizing the stream. Includes bed-load calculations, and gives estimates of the bed-load capacity in various sections of the stream channel. Makes various recommendations to alleviate flood and sediment damages.
9. Surface-runoff and infiltration. Amer. Geophys. Union, Trans., vol. 26, no. 3, pp. 431-434, Dec. 1945.
Discusses the general aspects of surface-runoff and infiltration. Considers the problem of sediment movement, infiltration and runoff. Notes phenomena observed in bed-load experiments which are concerned with infiltration. Points out the importance of reduction of sediment and of output of water of a watershed by work in the watershed itself.
10. Sediment movement in Pacheco Creek. U. S. Soil Conserv. Serv., Off. Res., TR-77-CF-Ri, 16 pp., illus., Jan. 1946.
Deals with the sediment problem of Pacheco Creek near Hollister, San Benito County, Calif. Two problems of sediment transport were needed to be worked out for a project of channel improvement to protect the land from flooding. The solution of these problems was worked out by the new analytical method for calculating the capacity of a stream to transport bed load as described in Bed-Load Transportation in Mountain Creek (Einstein, H. A., 7).
11. Determination of rates of bed-load movement. Fed. Inter-Agency Sedimentation Conf., Denver, 1947, Proc., pp. 75-90, illus., 1948.
Considers various methods of determining rates of bed-load movement. Reviews various types of bed-load samplers. Comments on direct bed-load measurement and the analytical determination of bed-load rates; notes that only the analytical method can be used in the design of new stream channels and in prediction of their stability.
Discussion: H. K. ARMSTRONG, pp. 91-92, commends Dr. Einstein for his treatment of methods used in bed-load measurements. Treats of the author's use of the bed-load function. Notes several methods proposed for dealing with size

distribution and grading. Treats of the utilization of a pseudo-density variable in the analysis of transport data and points out that boundary roughness plays a predominant role in the case of open channels. Recognizes the need for further research in the fields of sediment mixture and bed roughness. BILLY T. MITCHELL, p. 92, points out that poor results were obtained from a bed-load sampler in the Missouri. THE AUTHOR, p. 92, notes that the sampler was developed by the Dutch for a stream of low rates of transport and low flow. BILLY T. MITCHELL, pp. 92-102, presents a paper entitled Rapid Changes of Missouri River Streambeds, which deals with supersonic-echo sounding equipment in making rapid quantitative measurements of bed changes in large alluvial streams. Describes technique, evaluates resultant data, and shows difficulties encountered. D. V. C. BIRRELL, pp. 102-114, presents a paper which is the result of efforts of the Washington District Office, Corps of Engineers, to find basic data for the design of stable flood channels so as to minimize maintenance dredging. Gives a digest of a paper entitled Stable Channels in Alluvium (Lacey, G., 1). Considers a discussion of the Lacey formulas for stable channels and a development of the Lacey formulas to show relationships of scale and distortion in model tests. Includes a treatment of the Meyer-Peters formula for computing bed-load movement, which is used to integrate the Lacey hydraulic section with the idea that rivers in flood will determine, if not restricted, their own stable section.

12. Determination of bed load [abstract]. Civ. Engin., vol. 19, no. 5, p. 329, May 1949.
Presented at the ASCE Hydraulics Division meeting in Oklahoma City which deals with the determination of bed load. Points out that the two main purposes of bed-load determinations are to predict the stability of stream channels and the life expectancy of reservoirs. Several bed-load samplers are described. Notes that an analytical approach by calculating the movement of each grain size must be used in design problems where it is impossible to measure directly the bed load. The actual transport of a given grain size is found by proportional reduction to the frequency of occurrence of these particles in the bed and total transport of all sizes is obtained by the addition of the fractions.
- EISENHART, CHURCHILL.
1. A test for the significance of lithological variations. Jour. Sedimentary Petrology, vol. 5, no. 3, pp. 137-145, Dec. 1935.
States that the idea of homogeneity depends on the classification used. Describes the Chi-Square Test as a criterion to test for homogeneity corresponding to a certain classification. This test can be used to indicate if a given deposit is homogeneous throughout in a statistical sense, and to show if several deposits can be considered as mutually homogeneous.
- EISENMENGER, WALTER S. See Kucinski, K. J., 1.
- ELAM, W. E. See Matthes, G. H., 6.
- ELIASSEN, ROLF. See Camp, T. R., 2.
- ELIASSEN, SIGURD. See also Lane, E. W., 4; Todd, O. J., 5, 10.
1. Flood flow of the Yellow River. Assoc. Chinese and Amer. Engin., Jour., vol. 15, no. 5, pp. 18-38, illus., Sept./Oct. 1934.
Describes flow conditions during the flood of 1933. Includes brief discussion on flood damages, noting those due to the deposition of sediment, and gives results of observations on the sediment discharge of the stream.
2. The Saratsi Irrigation Project. Assoc. Chinese and Amer. Engin., Jour., vol. 16, no. 3, pp. 149-153, May/June 1935.
Describes difficulties which have prevented the passage of water through the canal and main branches of the Saratsi Irrigation Project in Suiyuan, China, for 2 1/2 yr. after the formal openings. Heavy flow from the mountains brought a large quantity of sand and silt, breaking the canal banks and depositing silt in the canal. Observes that obstacles do not doom a

- canal, citing flood and silt difficulties overcome by the Imperial Valley Irrigation Project. Recommends methods for silt elimination and control.
3. Soil erosion and river regulation with special reference to the Yellow River. Assoc. Chinese and Amer. Engin., Jour., vol. 17, no. 1, pp. 22-38, illus., Jan./Feb. 1936.
Describes conditions of surface and gully erosion in northwest China as they affect the regulation of rivers, particularly the Yellow River. Conditions of the transportation of sediment by the streams of North China and its deposition in streams and upon valley lands are considered. Discusses the inapplicability of employing settling basins in the plains region of the Yellow River. Proposes erosion control measures on watersheds of silt-bearing streams.
 4. Possibility of Yellow River flood control by means of detention basins. Assoc. Chinese and Amer. Engin., Jour., vol. 17, no. 4, pp. 211-230, illus., July/Aug. 1936.
Discusses the feasibility of Yellow River silt and flood control by means of detention basins. Shows the effect of a dam and detention basin located in the Meng Tsin-Shanchow region, the physiographic and geological description of the region, flood-flow characteristics of the Yellow River, silting action in proposed reservoir upstream from Meng Tsin, destructive outflow velocities, and the effect of control on conditions of scouring and silting of downstream river bed.
 5. Alluvial loess and the silt carrying capacity of Hopei rivers. Assoc. Chinese and Amer. Engin., Jour., vol. 17, no. 5, pp. 267-292, illus., Sept./Oct. 1946.
Analyzes the silt condition of the different Hopei streams, with particular reference to the flood problem, and considers the influence of the silt action of the Yellow River compared to that of the Hopei streams. Includes discussion on the composition and behavior of alluvial loess. Results of analyses of river silt are given.
Discussion: E. W. LANE (Assoc. Chinese and Amer. Engin., Jour., vol. 18, no. 2, pp. 130-133, illus., Mar./Apr. 1937), considers the effect of the reservoir on the Yellow River above Meng Tsin upon conditions of silting and scouring in the river bed below the dam. THE AUTHOR, pp. 134-138, comments on Lane's discussion, and considers anew the silting action in and above the proposed reservoir and its probable effect upon silt outflow from the reservoir.
 6. Alluvial loess and the silt carrying capacity of Hopei rivers. Assoc. Chinese and Amer. Engin., Jour., vol. 17, no. 6, pp. 364-387, illus., Nov./Dec. 1936.
Presents results of systematic silt measurements carried out on various Hopei rivers, 1918-21. Describes land building action of the streams.
 7. Alluvial loess and the silt carrying capacity of Hopei rivers. Assoc. Chinese and Amer. Engin., Jour., vol. 18, no. 1, pp. 38-58, illus., Jan./Feb. 1937.
Presents further data on results of systematic silt measurements carried out on various Hopei rivers, 1919-21. Land building action of the streams and present changes of the Chihli Gulf coast line are described.
 8. Can dredging be of use in the regulation and maintenance of the North China Rivers? Assoc. Chinese and Amer. Engin., Jour., vol. 19, no. 1, pp. 21-27, Jan./Feb. 1938.
Reviews critically the practicability of utilizing dredging methods for the regulation and maintenance of rivers of North China with particular reference to the Yellow River. Includes comments upon the influence of the delta of the Yellow River on the course upstream.
 9. The Hopei rivers. Assoc. Chinese and Amer. Engin., Jour., vol. 19, no. 2, pp. 79-89, Mar./Apr. 1938.
Discusses problems of river control on the Hopei Province, China, flood damages of 1937, sedimentation regimen of the net of rivers and canals near Tientsin and possibilities for silt control, silt problem at proposed reservoir across Yung Ting Ho gorge in Huailai Hsien, and flood and silt control of the Yung Ting Ho.
- ELKIND, B. See Blaess, A. F., 1.
- ELLIOTT, SIR CHARLES A. See Buck, Sir E. C., 2.
1. (and May, Ross R.). Bank protection for new river channel. Engin. News Rec., vol. 125, no. 25, pp. 61-63, illus., Dec. 19, 1940.
Describes engineering details of bank protection work on the new channel of the Arkansas River at Pueblo, Colo. Construction details of drainage facilities to relieve bad seepage conditions and of grouted rock slope paving of south bank of river are described. Slope paving of the south bank of the river rests on a concrete toewall supported on rock.
- ELLIOTT, DABNEY OTEY.
1. The improvement of the lower Mississippi River for flood control and navigation. 3 vols. Vicksburg, Miss., U. S. Waterways Expt. Sta., 1932.
Outlines the history of the improvement of the lower Mississippi River for flood control and navigation; noting its physical and hydraulic characteristics. Summarizes 100 yr. of cumulative experience and study of the River. Treats bank protection, dredging, flood control, and sedimentary matter in motion. Considers hydraulic traction and hydraulic suspension of sediments. Treats sand waves and their movement. Gives a history of the investigation of the action of sediment which begins with samples taken by Captain Talcott in 1838. Includes data on the sediment load of the Mississippi River.
- ELLIOTT, MALCOLM.
1. River navigation extended by open-channel expedients - Part I. Characteristics of rivers permitting open-channel methods. Civ. Engin., vol. 16, no. 11, p. 489, Nov. 1946.
Discusses the improvement of navigation by open-channel methods in silt-laden streams.
- ELLIS, M. M.
1. Some factors affecting the replacement of the commercial fresh-water mussels. U. S. Bur. Fisheries, Fishery Cir. 7, 10 pp., Dec. 1931.
Notes studies on natural replacement in various localities of the United States, and the effect of pollution by trade effluents and municipal wastes on replacement. Discusses the factor of erosion silt in producing changes in river conditions throughout the Mississippi system. Erosion silt is destroying a large portion of the mussel population by smothering with thick deposits of mud and blanketing sewage.
 2. (and Ladner, Grover C.). Attacking the nation's water polluting menace. Amer. Game Conf., Trans., vol. 21, pp. 135-140, 1935.
Discusses stream pollution, the nature of the pollutants, and their effect on fish life. Includes two paragraphs (p. 136) on the manner erosion silt affects the conditions of the stream, fish food, and fish life.
 3. Effects of pollution on fish. North Amer. Wildlife Conf., Proc., vol. 1, pp. 564-567, 1936.
Discusses the effects on fish of pollution from uncontrolled soil erosion and municipal and industrial wastes. Effects of pollution include destruction of fish food, destruction of favorable conditions of bottom, blanketing of spawning grounds, and alteration of quantities of dissolved gasses and other substances in the water.
 4. Erosion silt as a factor in aquatic environments. Ecology, vol. 17, no. 1, pp. 29-42, illus., Jan. 1936.
Considers the effect of erosion silt on aquatic life based on observations at over 700 stations of the Mississippi-Ohio-Missouri system and other interior waters, and laboratory experimental work carried on at the U. S. Bureau of Fisheries laboratories at Columbia, Mo. and Ft. Worth, Tex. Silt affects aquatic environments by screening out light, changing heat radiation, blanketing stream bottoms, and retaining organic and other substances which create unfavorable bottom conditions. Includes discussion of effect of silt on light penetration, on various wave lengths of visible light, and on alteration of rate of temperature change of river water. Discusses distribution of silt in water in relation to thermal stratification, effect of silt on salt content and amount of electrolytes in river waters, experimental studies

of the effect of silt on mortality rate of fresh-water mussels, and amount of organic matter carried to bottom of Lake Pepin and Lake Keokuk.

5. Detection and measurement of stream pollution. U. S. Bur. Fisheries, Bul., vol. 48, pp. 365-437, illus., 1937.
Presents results of a study of pollution hazards to fresh-water fishes. Includes discussion on the effect of erosion silt and other suspensoids on fresh-water fish life. Summarized data on turbidity and light penetration into various stream waters are presented.
6. Pollution and aquatic life. Amer. Wildlife, vol. 26, no. 3, pp. 38, 45-46, illus., May/June 1937.
Reviews the limitations inherent in various plans for the rectification of the detrimental actions of stream pollution and silting on fishes and other aquatic life.
7. Pollution of the Coeur d'Alene River and adjacent waters by mine wastes. U. S. Bur. Fisheries, Spec. Sci. Rpt. no. 1, 61 pp., 1940.
Discusses the pollution by mine wastes entering the Coeur d'Alene River in Idaho. Effects on plant and animal life are included. Recommendations are made to remedy the problem.
8. Water conditions affecting aquatic life in Elephant Butte Reservoir. U. S. Bur. Fisheries, Bul. 34, pp. 257-304, illus., 1940.
Presents results of an investigation (1935-39) of the physical and chemical characteristics of the waters of Elephant Butte Reservoir with particular reference to the effect of these conditions upon the aquatic life. Includes brief discussion on the effect of silt-detritus load entering the lower lake upon oxygen demand in the lake. Presents detailed data on turbidity determinations in the lake, and underflow.

ELLIS, T. G.

1. The causes of the formation of bars at the mouths of rivers, as shown in an examination of the Connecticut River. Amer. Soc. Civ. Engin., Trans., vol. 2, no. 71, pp. 313-322, illus., 1873.
Discusses character of river describing watershed conditions and noting that all tributary streams bring down detritus in freshets; and character of banks, noting that between Northampton, Mass. and Rocky Hill, Conn. banks cave and furnish great amounts of silt to the stream which results in continual changing of its bed. Gives data on stream discharge. Describes nature of bars at the mouth of the river, the effect of tides and tidal currents, changes in form and state of bars, and the causes affecting such changes. Gives theories of bar formation, and example of bar formation at mouths of other streams, and factors affecting the formation.

ELLIS, W. M.

1. The Kistna Reservoir silt problem. Engin. Conf., Simla, vol. 2, pp. 22-65, illus., 1913.
Presents results of studies in connection with the preparation of a project for the construction of a large reservoir on the Kistna River. Describes the Kistna River, the proportion of silt carried in suspension by the stream, the annual volume of silt carried and available silt observations, the Assuan reservoir silt problem, conditions which enable the Nile reservoir silt problem to be treated compared with conditions in the Kistna reservoir, rules for working the Kistna reservoir and the effect of its operation on stream regimen. Computes the estimated quantity and disposition of deposited silt in the Kistna reservoir, and estimates the effective life of the reservoir.

ELLISON, O. T. See also Ellison, W. D., 3, 4.

1. Measuring equipment used in watershed and hydrologic studies. Agr. Engin., vol. 18, no. 3, pp. 107-110, illus., Mar. 1937.
Describes equipment and methods employed to measure runoff and silt sampling at Coshocton, Ohio. Contains four paragraphs on types of silt samplers and flumes used, specifically Savage, Tait-Binckley, Ramser, and Eakin samplers, Parshall flumes and Columbus type control weirs. Describes installation of equipment at typical gaging stations, and notes equipment used in measuring soil moisture.

2. Soil erosion studies; V. Soil transportation in the splash process. Agr. Engin., vol. 28, no. 8, pp. 349-351, 353, illus., Aug. 1947.

Discusses the process of transportation of soil by splash erosion process of falling raindrops. Gives the method used in determining the transportation of soil by raindrops and reports the results of experimental work at Coshocton, Ohio. Considers the factors effecting this mode of transportation, and states the fact that large amounts of soil may be transported down steep hillsides by the splash process.

3. (and Ellison, O. T.). Soil erosion studies, VI. Soil detachment by surface flow. Agr. Engin., vol. 28, no. 9, pp. 402-405, 408, Sept. 1947.
Discusses flowing surface water and its ability to scour and transport eroded material.
4. (and Ellison, O. T.). Soil erosion studies, VII. Soil transportation by surface flow. Agr. Engin., vol. 28, no. 10, pp. 442-444, 450, Oct. 1947.
Discusses soil transportation by flowing surface water as shallow, pre-channel, or sheet flow and as channelized flow. Presents data on the relationship and of transportation factors, the transportability of soil, and the transporting capacity of the surface flow. Discusses other factors affecting soil transportation.

ELLMs, JOSEPH W. See Parmelee, C. L., 1.
ELLMs, R. W.

1. Device secures accurate samples from subaqueous silt beds. Engin. News-Rec., vol. 107, no. 26, pp. 1011-1012, illus., Dec. 24, 1931.
Comments on the development of a sampler for use in studying coal-laden silt in the reservoir behind Holtwood Dam on the Susquehanna River. Sampler consists of two seamless steel tubes, one within the other. The inner tube is divided into compartments by spacers and each compartment is fitted with a cup. At the top of each compartment 180-degree openings were cut through both tubes which, when matched, admit material to the pocket and when rotated 180 degrees seal the entrance. Use of the sampler is described. Silt deposits up to 60 ft. in depth were found at Holtwood Dam.

ELMENDORF, HAROLD B. See Munns, E. N., 5.

ELSDEN, F. V. See also Rothery, S. L., 2.

1. Irrigation canal headworks. Punjab Public Works Dept., Irrig. Br., Papers, 25, 19 pp., illus., Apr. 26, 1922.
Presents some suggestions for the more efficient design of canal headworks to exclude silt from Punjab canals and distributaries.
2. Skimming rivers for irrigation water [abstract]. Engineer [London], vol. 134, pp. 485-486, illus., Nov. 8, 1922.
Deals with the effect of silt on irrigation works and the possibilities of its exclusion from canals. Describes the design of a proposed canal-head regulator.
3. Exclusion of silt from irrigation work [abstract]. Engin. and Contract., vol. 58, no. 22, pp. 516-517, illus., Nov. 29, 1922.
A contribution to the papers of the Punjab Irrigation Branch concerning the exclusion of coarse sandy silt from irrigation canals. Discusses the transporting power of streams, noting the effect of vertical eddies at canal regulators; in causing the entrance of heavy silt into canals. Describes design of the head regulator, super-imposed on undersluices for skimming off top water, gives details of sluice and skimmer gates, reports method of operating the regulator. Presents the cost of the proposed headworks.

ELSDEN, OSCAR.

1. Investigation of the outer approach-channels to the Port of Rangoon by means of tidal model. Inst. Civ. Engin., Jour., vol. 12, no. 7, pp. 3-29, June 1939.
Describes conditions in the Irrawaddy Delta and Rangoon Estuary. Rate of the advance of the shore line of the Gulf of Martaban is noted. Gives the silt content of the Myitthaka-Hlanig and Panhlaing Rivers. Comments on channel silting and changes in the regimen of the Rangoon River. Gives study of remedial works and final decisions reached.

EMERY, K. O.

1. Rapid method of mechanical analysis of sands. *Jour. Sedimentary Petrology*, vol. 8, no. 3, pp. 105-111, illus., Dec. 1938.
Describes the use of a settling tube, and notes its advantages over sieving.
2. Sediment size distribution code. *Geol. Soc. Amer. Bul.*, vol. 56, no. 12, pt. 2, p. 1157, Dec. 1945.
Proposes a system of expressing the size composition of sediment by a series of numbers representing grade-size limits instead of using median diameter and the coefficient of sorting and skewness.
3. (and Gould, Howard). A code for expressing grain size distribution. *Jour. Sedimentary Petrology*, vol. 18, no. 1, pp. 14-23, illus., tables and graphs, Apr. 1948.
Describes the development of a new coding method for expressing grain-size distribution; this method was developed because of the necessity for quickly analyzing and plotting large suites of marine bottom samples. Gives estimates of median diameter, sorting coefficient, and skewness. Diameters of grains can be obtained from the code in either microns or in the phi notation.

EMMONS, W. H.

1. (and Laney, F. B.). *Geology and ore deposits of the Ducktown Mining District, Tennessee*. U. S. Geol. Survey, Prof. Paper 139, 114 pp., illus., 1926.
Deals with the geology and ore deposits of the Ducktown mining district, Tennessee, and mining, metallurgy and acid manufacture in the district. Conditions of recent erosion and deposition in the district are briefly described.

ENDERSBEE, W. J. See Bailey, R. W., 5.

ENGELN, OSCAR DIEDRICH VON.

1. Falling water. *Sci. Monthly*, vol. 28, pp. 422-429, illus., May 1929.
Discusses erosive action of falling water. Various waterfalls are described and deductions made as to their formation by stream flow and abrasive effect of silt and sand.
2. Deposition of sediment in lakes by glacial streams. *Natl. Res. Council, Bul. no. 89*, pp. 226-227, Nov. 1932; also in *Science*, n. s., vol. 73, no. 1890, pp. 313-314, Mar. 20, 1931.
Reports results of observations regarding delta deposition under specific conditions. Discharge of the Rhone River into Lake Geneva, at the time of observation, indicated to the writer that sediment-laden cold waters of the stream sank beneath the surface of the warm lake waters; sinking was abrupt and complete at the outer edge of top-set beds; depth of the lake was adequate to form a thick delta deposit with a maximum of steepness to the fore-set beds. Deductions are fulfilled by the form and composition of hanging deltas in the Finger Lake District of New York. Similar conditions were observed June 15, 1930 by the writer where the Lutschinen stream empties into Lake Brienz, Switzerland. Discharge of the warm Cayuga stream waters into the colder waters of Lake Cayuga, N. Y. has the effect of spreading the deposit.

3. *Geomorphology*, 655 pp., illus. New York, Macmillan Co., 1942.
A textbook on geomorphology containing several chapters which have some discussion of cycles of erosion, stream patterns, meanders, work of streams, etc. Various other subjects pertaining to geomorphology are discussed.

ENGELS, HUBERT. See also Freeman, J. R., 3.

1. The limits attainable in improving the navigability of rivers by means of regulation. *Amer. Soc. Civ. Engin. Trans.*, vol. 29, pp. 202-222, July 1893.
Outlines the extent to which a river can be regulated in the interests of navigation. Discusses the energetics of a stream relative to its action in straight stretches and in beds, noting in particular conditions of scour and transportation and deposition of suspended material and bed load. Interprets the action of a tributary in altering the energy characteristics of a stream. Describes a model study undertaken by the author relative to sediment transportation by a stream. States in conclusion that streams in which natural erosion is fully

developed are adapted to regulation by adjustment of the slope of the low-water line, and the depth is maintained by the use of formulas derived in the paper.

Discussion: WILLIAM MURRAY BLACK, (*Amer. Soc. Civ. Engin. Trans.*, vol. 30, pp. 493-494, Dec. 1893) notes in three paragraphs the action of a stream at a bend in the river and the conditions of erosion and deposition during and after flood flow. W. R. KING, pp. 494-496, includes one paragraph noting conditions of channel improvement at shoal places on the Tennessee River by cutting through obstructions and contracting the channel by wing dams or by closing side channels.

2. Regulation of the lower Mississippi [letter to editor]. *Civ. Engin.*, vol. 1, no. 15, pp. 1396-1397, Dec. 1931.

Discusses methods of regulating rivers to control floods and maintain adequate navigation facilities. Suggests retention of flood waters in reservoirs, dredging of bars, and partial diversion of flood water. Notes that the Mississippi River is not always charged to maximum sediment capacity and at high water the river holds little more sediment per cubic foot than at low water.

3. (and Kramer, Hans). Large-scale experiments in river hydraulics. *Civ. Engin.*, vol. 2, no. 11, pp. 670-674, Nov. 1932.

Describes large-scale model experiments at the hydraulic laboratory near Walchensee, Germany, to determine the travel of sedimentary material transported along the bed of a sinuous river channel and to determine the effect of various levee locations on the movable bed. This article is a condensation of a translation of Dr. Engels' report printed in *Wasserkraft und Wasserwirtschaft*. Describes the experimental plant, plan and scale of model, and method of conducting the experiments, and discusses the results.

ENGEZ, SELAHATTIN M.

1. An extension of the study of boundary influence on the fall velocity of spheres. Thesis (M.S.) - State University of Iowa, Jan. 1948; [abstract], Iowa Univ. Studies in Engin., Bul. 33, pp. 58-59, 1949.
Utilizes the equipment and techniques developed by McPherson (McPherson, M. B. 1) to extend previous experimenters' results on the effects of a coaxial cylindrical body on the fall velocity of spheres. Determines the coefficient of drag for sphere-to-cylinder diameter ratios from zero to 0.98 and for Reynolds numbers of the spheres from 0 to 1,000. Notes that for a given Reynolds number, inertial effects were shown to decrease with increase of diameter ratio. Verifies experimentally analytical results for small diameter ratios and a functional trend derived for diameter ratios nearly equal to unity.

ENGINEER CORPS. See U. S. Engineer Dept.

ENTENMANN, PAUL M. See also Rothery, S. L., 1.

1. Flood danger in the Colorado Delta. *Engin. News-Rec.*, vol. 98, no. 13, pp. 532-535, illus., Mar. 31, 1927.

On the danger of disaster to the Imperial Valley since the Colorado River has no clear channel to the sea. Discusses erosion, noting recession of a large gorge at the rate of 8 miles per month when the Colorado River flowed through New River into Salton Sea (1905-06). The percentage of silt carried by the Colorado River varies between 0.5 and 4.0 percent corresponding to fluctuation in velocity. Discusses effect of sedimentation on channel changes of the Colorado River for various periods of time. The proposed solution is an eastern channel connecting the tidal estuary to the Gulf of California where delta formation would be slow and over a large area. Notes proposed repair work on Pescadero diversion, and on Volcano Lake, Bee River and Pescadero levees.

ERVINE, A. L.

1. An attempt to determine the amount of chemical erosion taking place in the limestone (Calcliferous to Trenton) Valley of Centre Co., Pa., and hence applicable to similar regions throughout the Appalachian System [abstract]. *Amer. Assoc. Adv. Sci.*, vol. 33, pp. 404-405, 1884.

ERVINE, A. L. - Continued

Address before the 33rd meeting of Section E of the American Association for the Advancement of Science, Sept. 1884. Presents results of an investigation to determine the amount and rate of land surface reduction in Spring Creek basin, Centre County, Pa., based on stream flow and sediment observations.

ESCHMEYER, R. W.

1. (and Clark, O. H.). Analysis of the populations of fish in the waters of the Mason Game Farm, Mason, Michigan. *Ecology*, vol. 20, no. 2, pp. 272-286, illus., Apr. 1939.

Studies made to determine fish population in Little Mud Creek, Big Mud Creek and Mason Game Farm Pond located on the Mason Game Farm in Mason County, Mich. Includes one paragraph relative to silting of the 8 1/2-acre Mason Game Farm Pond, 75 years old and formerly a saw-mill pond, which has silted so that the average depth is not over 3 ft.

ETCHEVERRY, BERNARD A.

1. Irrigation practice and engineering, vol. 2, Conveyance of water. 364 pp., illus. New York, McGraw-Hill Book Co., Inc., 1915.

Deals with the various problems involved in the design of irrigation canals and structures. Includes discussion on silt problems in the design of irrigation systems, such as silt fertility, amount of silt in irrigation waters, silt content of river waters used for irrigation, distribution of silt in stream cross-section, theories regarding sediment transportation, and the prevention of silt deposits in canals.

2. Irrigation practice and engineering, vol. 3, Irrigation structures and distribution system. 438 pp., illus. New York, McGraw-Hill Co., Inc., 1916.

Presents various data on irrigation structures and distribution systems. Includes discussion on the necessity for, method of operation of, efficiency of, and design of scouring sluices; and description of scouring sluices of Granite Reef Diversion Works on Salt River, Ariz., Yuma Project Diversion Works on Colorado River, Ariz.-Calif., Murrumbidgee Diversion Works, New South Wales, Australia, and Corbett Diversion Works, Shoshone River, Wyo.

3. Land drainage and flood protection. 315 pp., illus. New York, McGraw-Hill Book Co., Inc., 1931.

Deals with the surface drainage and under-drainage of agricultural land affected by excessive water due to precipitation or irrigation, and the protection of lands against flood and tide waters. Includes discussion on silt transportation and the flow of water in stabilized river channels in alluvium.

ETNYRE, S. L.

1. Drainage plans and recent improvements of same at Council Bluffs, Iowa. *Iowa Engin. Soc., Proc.* 18, pp. 10-12, 1906.

Improvements involve the removal of sediment from and the prevention of future deposits in the channel of Indian Creek.

EVANS, JOHN WILLIAM.

1. The wearing down of the rocks. *Geologists' Assoc. Proc.*, vol. 24, pt. 5, pp. 241-300, 1913.

Deals with the processes involved in the disintegration of rocks. Treats the mechanical action of running water, the force exerted on the river bed, abrasion by detritus, variations in river channels, river erosion, etc.

EVANS, LEWIS.

1. A brief account of Pennsylvania, 1753. In Gipson, Lawrence Henry. *Lewis Evans*, pp. 87-137. Philadelphia, Hist. Soc. Pa., 1939.

Describes the Delaware River, including adjacent marsh flats which are cultivated. Because of clearing of land and washing of soil into streams, several creeks mentioned by William Penn as being navigable are no longer so. So many bars occur at the mouth of the Schuylkill that no shipping can enter it.

EVANS, LLEWELLYN.

1. Silt disposal at Tacoma Hydro-Electric Plant. *Power*, vol. 51, no. 18, pp. 694-697, illus., May 1920.

On silt problems at Tacoma Municipal Hydro-Electric Plant on Nisqually River, a glacial stream from Mt. Ranier. Diversion dam, tunnel

and penstock allow 425 ft. head. Intake is through a 4 1/2 in. screen, forebay, and settling channel with washout gates. Further settling is provided in regulating the reservoir with washout gates and sluicing pump. Settlement in one year was 3-7 ft. Beyond 400 sec. ft. (during floods) these headworks do not keep silt out of the plant, resulting in wearing and cutting the turbine and clogging of piping by the fine sharp sand. Washout gates are clogged with debris during flood, choking intake screen, and allowing silt to pile up. On breaking up clogged debris, piled-up sand enters the reservoir. Flood experience in 1917, 1918, and 1919 led to construction of a drift barrier, alterations to headworks and changes in use of gates. The drift barrier, parallel to stream flow, successfully handled an ice jam.

2. Silt disposal at Nisqually Power Plant. *West. Construct. News*, vol. 7, no. 24, pp. 725-726, illus., Dec. 1932.

Describes headwaters of the Nisqually River, a glacial stream from Mt. Rainier, and drift barriers to keep driftwood out of the Tacoma Municipal Hydro-Electric Plant, as well as the method of cleaning drift from barriers. Originally silt piled up behind drift, requiring dredging to clear screens and washout gates. Then barriers were re-designed. In the summer, the turbidity of the river water is 60-70 p.p.m. During floods, the solid content rises to 0.13 grains per c.c. By reducing the plant load during floods, sand is given a chance to settle out in the pond, settling channel, channel behind distributing weir, and forebay. Silt erosion has necessitated replacement or repair of valves, piping, turbine runners, linings, and wickets.

EVANS, OREN F.

1. Some observations on erosion and transportation in the Wichita Mountain area. *Okla. Acad. Sci. Proc.*, vol. 2, pp. 77-79, 1922.

Discusses processes of erosion, and transportation of material into the Red River and the North Fork of the Red. During the greater part of the year the volume of water is small and only finer particles are carried down. At times of high water, the river cuts channel beds to rocks 30-50 ft. below. Deposition takes place in these cuts on falling stage of river. Thus it may be possible for a stream to appear to be aggrading while actually it is degrading its bed.

2. Some observations of the South Canadian River near Norman. *Okla. Acad. Sci. Proc.*, vol. 3, pp. 120-123, 1923.

Describes the South Canadian River in Oklahoma in contrast to streams of humid regions. The South Canadian has a broad flat valley and a sand-choked bed common to streams of the Great Plains country. The river is not necessarily an aggrading stream but depends upon the amount of scour occurring during high water compared to the amount of fill at times of low water. From the relation of the present stream bed to the previous one, and also to terraces, it appears that the river at present is degrading but may have aggraded in the past and may do so again in the future. Wind-blown sand is continually deposited on the north banks of streams in Oklahoma giving rise to the suggestion that streams are migrating southward.

3. Some processes in the formation of the stream valleys of the interior plains region of the United States. *Okla. Acad. Sci. Proc.*, vol. 5, p. 150, 1925.

Stream valleys in Oklahoma are characterized by broad valleys with a deep trench. Valley forms are the result of differences in climate and rock structure as compared to streams of humid regions. The erosion process of surface and subsurface sapping is most important in cutting the trench. Repeated flooding and deposition of sediment on the valley flat causes it to appear as a flood plain.

4. A stream valley type of Oklahoma. *Okla. Acad. Sci. Proc.*, vol. 6, pt. 2, pp. 229-231, 1926.

Deals with a common type of stream valley in Oklahoma which consists of a broad flood plain with trench (in general the flood plain is 20-30 times the width of the trench) winding through it. The trench has not been formed as

a result of stream rejuvenation since streams are aggrading. Cites as examples the South Canadian River and Middle Otter Creek. Discusses conditions under which erosion and deposition take place in Oklahoma.

5. Some reasons for the parallel courses of streams in Oklahoma. *Okla. Acad. Sci. Proc.*, vol. 7, pp. 152-154, 1927.

Discusses the unusual parallelism of streams traversing the Great Plains region, the reasons being that they flow through a semi-arid region, they are aggrading, prevailing winds pile sand along the sides of the stream, in some places they may be following a structural folded surface, and sub-surface sapping may have helped to hold them parallel to the direction of folds as they were working headward.

6. Transportation of sediments on fresh-water surfaces by flotation. *Jour. Sedimentary Petrology*, vol. 8, pp. 33-35, Apr. 1938.

Observations on the transportation of sediments on the surface of some Michigan fresh-water lakes. Discusses mechanical analyses of transported material, conditions of suspension and transportation, effect of grain size and shape on ability of material to be transported, and effect of small waves and winds on extent of transportation.

EVANS, P. See Dryden, L., 3.

EVERATT, ERIC LAUNCELOT.

1. Maintenance dredging in Bombay harbour and docks, and upkeep of the navigational lighting of the port. *Inst. Civ. Engin., Selected Engin. Papers*, 41, 35 pp., illus., 1926.

Presents detailed data on the means employed and costs of maintenance dredging in the Bombay harbor. Results of a siltation survey carried out in 1921-23 are briefly given. Discusses silt-trap employed, estimated average annual deposit in various portions of the harbor, source of silt, chemical and mechanical analyses of silt, and means of silt removal.

EVERHAM, A. C.

1. New type of mattress used for river-bank protection. *Engin. News*, vol. 76, no. 22, pp. 1022-1023, illus., Nov. 30, 1916.

Describes the new type of mattress used for bank protection by the Wabash Ry. on the Missouri River, the method of bank protection used by U. S. Government engineers, and wire mats used for emergencies. Details and mode of construction are given.

FABER, EDUARD.

1. Das Verhalten der beweglichen Sohle in Geschiebeführenden Flüssen bei steigendem und fallendem Wasser (The behavior of movable bottoms in rivers transporting bed-loads at rising and falling water). *Bautechnik*, vol. 2, no. 39, pp. 425-430, Sept. 12, 1924. In German. Translation on file at U. S. Soil Conservation Service, Washington, D. C.

Discusses various theories and results of experiments relative to the effect of high and low waters in rivers transporting bed-load on the behavior of the movable bottoms.

FAHLQUIST, FRANK E. See Campbell, F. B., 1.

FAIR, GORDON M. See Slade, J. J., 2.

FAIRBANK, J. P.

1. (and Brown, J. B.). Some aspects of the St. Francis flood damage of interest to agricultural engineering. *Agr. Engin.*, vol. 9, no. 8, pp. 237-239, illus., Sept. 1928.

Reports flood damages to Santa Clara Valley caused by failure of the St. Francis Dam, Mar. 13, 1928. Describes losses and damage to agriculture, buildings, farm machinery, and irrigation systems. Notes deposition of debris on lands and discusses its removal.

FAIRBANK, LIEGH C., JR.

1. Pipe-line flow of solids in suspension; a symposium. Effect on the characteristics of centrifugal pumps. *Amer. Soc. Civ. Engin., Trans.*, vol. 107, pp. 1564-1575, illus., 1942.

An investigation to obtain the characteristics of a centrifugal pump of known dimensions while pumping in suspension material of different known sizes and concentrations, and also to consider a quantitative analysis of the change in characteristics due to the suspension material. Notes investigations by others which show

that pump characteristics are different for solid-water mixtures than for water alone.

Discussion: ARTHUR L. COLLINS, pp. 1587-1589, describes several measuring units which make up a system of measurement used by the writer in aid to the solution of problems in dredge operation. H. A. EINSTEIN, pp. 1589-1590, points out the lack of a short description of methods of making measurements.

FAIRCHILD, H. L.

1. Earth rotation and river erosion. *Science*, n. s., vol. 76, pp. 423-427, illus., Nov. 11, 1932.

Considers the right-hand deflecting force to which all moving bodies on earth are subject and its effect on erosion of right banks of rivers. Discusses theory of "deflective force" due to rotation of globe, and its theoretic application to rivers. Notes G. K. Gilbert's formula for estimating deflective force when combined with centrifugal force in stream impact on banks of curves or meanders, and the theoretical mechanics of absorption by earth of kinetic energy of moving bodies on earth. Observations of topography of New York show that valleys are equivocal or indifferent in respect to differences in slope of walls. Long Island streams used as examples of erosion by rotative deflection are actually having east banks eroded by east and southeast winds. Concludes that rotative deflective force is so small in its effect on stream erosion that it is immeasurable and negligible.

FAIRS, G. LOWRIE.

1. Apparatus for particle size analyses [letter to editor]. *Engineering*, vol. 154, no. 4011, p. 435, Nov. 27, 1942.

Notes an error in the series of articles entitled Apparatus for Particle Size Analysis (Anonymous, 179) in which types of particle-size apparatus were described by the Imperial Chemical Industries, Ltd.

FANTI, ARNALDO.

1. The technique and practice of reclamations. Milan, Italy, 1915. In Italian. Translation on file at U. S. Soil Conservation Service, Washington, D. C.

Describes methods of land reclamation in Italy by natural drainage, drainage by mechanical means, and reclamation by sedimentation. In respect to sedimentation, discusses in detail the quantity and quality of sediment transported by watercourses and the reclamation of land by sediment produced by sea tide and deposition of material from embanked rivers and torrents.

FARIES, CULBERT W.

1. Bullards Bar Dam, north fork of Yuba River, California. *West. Construct. News*, vol. 2, no. 8, pp. 39-41, illus., Apr. 25, 1927.

Notes that it is the highest dam that has been designed to be filled to its crest with sand and gravel; it is the first permanent large structure that has been built to restrain debris since the cessation of hydraulic mining in the late eighties. Gives details of design.

FARIS, ORVILLE A. See also Griffith, W. M., 2; Grover, N. C., 12.

1. The silt load of Texas streams. U. S. Dept. Agr. Tech. Bul. 382, 71 pp., illus., Sept. 1933.

A detailed study of silt transportation and deposition at various points along different rivers in Texas. Gives previous silt investigations in Texas by J. C. Nagle, 1899, 1900-02 on Brazos River at Jones Bridge, and on Wichita River at Wichita Falls, also W. W. Follett's summary of investigation 1899-1912, on Rio Grande at El Paso and San Marcial. Presents data on 19 sampling stations, and on method of sampling, laboratory methods for determination of percentage of dry silt by weight and saturated silt by volume. Reports investigations on bed silt. Discusses distribution of silt throughout stream cross-section and the relationship of quantity of silt to velocity of water, Brazos River at Rosenberg, Apr. 16, 1929. Gives mean percentage of silt by weight in cross-sections of streams (17 samplings), graphical comparison of relation between discharge and silt percentage at various depths, the relation between percentage of silt by weight and by volume after

settlement for 7 days, and the mechanical analysis of suspended silt, Brazos River at Aspermont, Seymour, and Waco. Silt survey of Medina Reservoir, Sept. 1925 is described. Total silt volume of 2,692 acre-feet was deposited in 13 yr. (annual average 207 acre-feet). The weight of dry material per cu. ft. of deposit equalled about 30 lbs. before sediment was exposed to drying. Gives mechanical analysis of sediment deposited at Medina Reservoir; average weight of dry compacted silt per cu. ft. of deposit is 63.6 lbs. Notes distribution of silt in reservoir. As a result of floods, reservoir becomes partly filled with clear water, and as muddy water does not mix with clear water it is forced downward toward dam. Discusses nature of silt in Medina Reservoir noting behavior of inflow, and the scouring of deposits. Gives mechanical composition and relation between volume and weight of deposited silt. Silt survey at Lake Worth, Apr. 1925 is described, and the distribution given of silt in lake. The total silt volume is equal to 10,890 acre-feet, an annual average of 1,000 acre-feet for 11 yr. In 1928 total silt volume equalled 13,837 acre-feet. Gives percentage of silt by weight, June-July 1928, and notes that Lake Worth is effective as a silt trap. Discusses character of silt in Lake Worth (10 samples) giving volume-weight determinations and mechanical analysis. Laboratory tests were made to determine rate of settling of Lake Worth silt. Reports distribution and specific weight of silt and rate of silting in Lake Kemp on the Big Wichita River and in the reservoir at Cisco. Discusses silting of Austin Reservoir on the Colorado River of Texas and gives annual rate of accumulation, distribution of silt in reservoir, compaction, and the specific gravity. Value and means of determining silt load, prevention of silting and removal of silt from reservoirs, sedimentation in irrigation canals of the lower Rio Grande Valley and the use of settling basins are discussed. Reports the effect of silt in sealing canals and the effect of velocity, width and depth of canal on sediment deposition according to Kennedy's law. Gives chemical composition of Brazos River water and conclusions. Appendix contains tables showing silt carried by various Texas streams based on discharge records of U. S. Geological Survey (Double Mountain Fork at Brazos River at Aspermont, 1924-30, Salt Fork of Brazos at Aspermont 1924-25; Clear Fork at Brazos at Elíasville 1924-25, and at Crystal Falls 1925-38; Brazos River at Seymour 1924-30, at Mineral Wells 1924-30, at Glen Rose 1924-29 at Waco 1924-30, at Rosenberg 1924-30; Little River at Little River 1924-29, San Gabriel River at Circleville 1924-1929; San Antonio River at Falls City 1927-30; Nueces River at Three Rivers 1927-30; Colorado River at Texas near San Saba 1930, at Tow 1927-30, at Columbus 1930; Rio Grande at Roma 1929-30; Neches River at Rockland 1930; and Red River at Denison 1930).

FARMER, H. D.

1. (and Lewellen, A. B.). Channel changes on forest highways. *Public Roads*, vol. 18, no. 9, pp. 169-175, 182, illus., Nov. 1937.

Describes design data on three projects in Oregon which exemplify the economy of constructing channel changes instead of bridges on forest highways. The material excavated from channel is used to construct roadways, and protect channel slopes. Channel design provides adequate carrying capacity.

FARRELL, RICHARD CRAIG.

1. Railway flood-works in the Punjab and Sind, relative to the North-Western State Railway. *Inst. Civ. Engin., Minutes of Proc.*, vol. 140, pp. 130-142, illus., 1900.

Describes effect of floods on soil erosion and scouring of the railway embankments. Protective measures employed are reported.

FAVRE, HENRY. See Meyer-Peter, E., 1, 2.

FAWCETT, P. N.

1. The training wall across the Liao Bar in Manchuria. *Assoc. Chinese and Amer. Engin. Jour.*, vol. 11, no. 7, pp. 23-36, illus., July 1930.

Describes various aspects of the improvement of the Liao River Bar by the construction of a single jetty in order to maintain a navigable channel at the Port of Niuchuang, Manchuria. Includes brief discussions on the nature of the bed of the bar, the formation of the bar by sediment brought down by the Liao River, channel maintenance during jetty construction, the advance of the 9-ft. contour, the quantity of material scoured from the bar, and channel maintenance after jetty construction.

Discussion: HERBERT CHATLEY (Assoc. Chinese and Amer. Engin. Jour., vol. 11, no. 11, pp. 33-34, Nov. 1930), describes the effectiveness of a single concave jetty in the regulation of the bar of the Wangpoo River. Results show that induced scour may be further intensified by the concentration of stream flow caused by a second wall. Notes nature of the material of the Wangpoo bar. H. C. RIPLEY (Assoc. Chinese and Amer. Engin. Jour., vol. 11, no. 11, pp. 34-36, Nov. 1930), notes the beneficial effect of the training wall, stating that the wall will need continual extension and may be subject to undermining. Describes an alternative plan utilizing a curved jetty.

FAWKES, A. W. ELLSON.

1. Water filtration in Minneapolis. *Munic. Engin.*, vol. 43, no. 6, pp. 355-364, illus., Dec. 1912.

Describes the filtration plant of Minneapolis, Minn. Gives brief data on the turbidity of Mississippi River water at Minneapolis, and on results of an analysis of deposited matter taken from the city reservoir.

FEAGIN, LAWRENCE B.

1. River navigation extended by open-channel expedients. VI. Dredging methods compared. *Civ. Engin.*, vol. 16, no. 11, pp. 494-495, illus., Nov. 1946.

Compares the cutterhead and dustpan types of dredges used in the Middle Mississippi navigation channel.

FEATHERLY, H. I.

1. Silting and forest succession on deep fork in southwestern Creek County, Oklahoma. *Okla. Acad. Sci. Proc.*, vol. 21, pp. 63-64, illus., 1941.

Describes the silt problem on the Deep Fork in Creek County, Oklahoma. Notes the effect of silt on two forests in the same area. One is an old dead oak-hickory forest and the other is a young ash-cottonwood-willow forest which has been climbing out as the silt has been deposited.

FEATHERSTONHAUGH, G. W.

1. Geological report of an examination made in 1834, of the elevated country between the Missouri and Red Rivers. 23d Cong., 2d sess., H. Ex. Doc., 151, 97 pp., illus., 1835.

Investigations on the mineralogical and geological character of the highlands and watersheds in the Ozark Mountain region. Discusses transparency of the Black River and its tributaries, the navigability of the Black River, and muddiness of the Missouri River. Notes early rafts and changes in the course of the Arkansas and Red Rivers. Reports damage of sand deposits to bottom lands by Arkansas flood of 1833. The color of Canadian, Red, and Foteau Rivers is due to variations in mineral matter transported by these streams. Reports quantity and quality of superficial deposits made in 10 yr. by inundations of the Arkansas River. Suggests experiments to determine the mean quantity of sedimentary matter brought down by the tributaries of the Mississippi at high and low water. Quotes from paper by L. Horner on method used by him to obtain suspended sediment determinations in the Rhine.

FEDERAL INTER-AGENCY RIVER BASIN COMMITTEE, SUBCOMMITTEE ON SEDIMENTATION. See U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation.

FEDERAL INTER-AGENCY SEDIMENTATION CONFERENCE, DENVER, 1947.

1. Proceedings. 314 pp., illus., tables, graphs. Washington, U. S. Bur. Reclam., 1948.

Consists of the papers and discussions presented at the Federal Inter-Agency Sedimentation Conference, held at the Bureau of Reclamation Laboratories, Denver, Colo., on May 6-8, 1947, under the sponsorship of the Federal agencies represented on the Subcommittee on Sedimentation of the Federal Inter-Agency River Basin Committee. Representatives of Federal agencies faced with various sedimentation problems discussed methods being used to investigate and solve them. The objective of the conference was an attempt to bring about better coordinated programs of investigations through the exchange of plans, accomplishments, and technical advances in the field of sedimentation. Papers presented are listed herein under names of authors.

FEDERATED MALAY STATES AND THE STRAITS SETTLEMENTS. DRAINAGE AND IRRIGATION DEPT.

1. Annual report, 1936, by A. G. Robinson. 143 pp., illus., 1937.

Seven chapters are on irrigation in Perak, Selangor, Negri, Sembelan, Pahang, Settlement of Penang, and Malacca. One is on drainage and one on conservancy of rivers which includes a description of river training works for silt control on the Bentong, Temiang, Sungei, Raia, Selangor and other rivers. Describes silting of the Serendah River at Serendah where cliffs of mining tailings 60 ft. high were left when dams were breached by floods.

FELD, JACOB. See Campbell, F. B., 1.

FELKER, RALPH H.

1. Streambank control. Utah Farmer, vol. 66, no. 16, pp. 3, 17, illus., Apr. 10, 1947.

Discusses stream-bank erosion and its effectiveness in cutting away fertile farm land. Describes methods of controlling stream-bank erosion which are useful to farmers.

FENNEMAN, N. M.

1. Flood plains produced without floods. Amer. Geog. Soc. Bul., vol. 38, no. 27, pp. 89-91, 1906.

Describes the process of flood plain production by lateral accretion on the inner side of a meander curve and cites flood plain of White River, Wis., as an example. Process of vertical accretion by deposition of suspended matter from flood waters is briefly considered.

2. Some features of erosion by unconcentrated wash. Jour. Geol., vol. 16, no. 8, pp. 746-754, Dec. 1908. Points out and accounts for the limitation of degree of minuteness on every dissecting land surface beyond which dissection will not go. Examines topographic effects of erosion without valleys.

FENWICK, G. P. See Simmons, H. B., 1.

FERGUSON, HARLEY B.

1. Construction of Mississippi River cut-offs. Civ. Engin., vol. 8, no. 11, pp. 725-729, illus., Nov. 1938.

Describes the cut-offs constructed on the lower Mississippi River and discusses their effects on the regimen of the stream. Between cut-offs, "corrective dredging" was employed to guide the river in its work and to ensure that the effects of the cut-offs would be carried sufficiently far upstream.

2. Effects of Mississippi River cut-offs. Civ. Engin., vol. 8, no. 12, pp. 826-829, illus., Dec. 1938. Discusses the effects of cut-offs, constructed since 1932, on the lower Mississippi River, on length, slopes, sections, and carrying capacity of the stream. "Corrective dredging" was employed to ensure the upstream effects of the cut-offs.

3. History of the improvement of the lower Mississippi River for flood control and navigation 1932-1939. 198 pp., illus. Vicksburg, Miss., U. S. Mississippi River Com., 1940.

A work which deals with new steps taken 1932-39 in the improvement of the lower Mississippi River for flood control and navigation. Comments on bank erosion and methods of stream-bank protection. Notes use of cut-offs and corrective dredging in directing the river's energy.

FERMOR, SIR LEWIS L.

1. Report upon the mining industry of Malaya. 240 pp., illus. Kuala Lumpur, Federated Malay States Govt. Press, 1940; [abstract], Nature, vol. 144, no. 365b, p. 901, Nov. 25, 1939.

Considers the damage done to agricultural land by various forms of mining. Notes that prevalent forms of tin mining result in floods of water which are heavily charged with silt and silt-retention schemes are necessary. Points out the damages caused by the mining process of destroying hillsides under hydraulic pressure; rubber cultivation is harmful also in ruining land because it encourages soil erosion and leads to the removal of fertile surface layers. Use of "clean weeding" causes soil erosion between rows of trees and can be prevented by wise use of cover crops. States that rubber cultivation has contributed 33,000,000 tons of silt to the rivers since 1905 and tin mining only 16,000,000 tons. Some of the silt fertilizes the soil.

FERTIG, JEROME H. See Fortier, S., 2.

FILMER, EDWIN A.

1. New periodotite dikes of Ithaca. Pan-Amer. Geol., vol. 72, no. 3, pp. 207-214, illus., Oct. 1939.

Discusses search for precious stones in weathered material of igneous dikes near Ithaca, N. Y. Great floods in summer of 1935 cleared waterways of age-old accumulations of debris, eroded stream banks, gullied fields, moved large boulders and caused heavy deposition in the lower reaches of the streams.

FINCH, H. A.

1. Earth-cement mixture in sacks used for river-bank revetment. Engin. News-Rec., vol. 122, no. 19, p. 659, illus., May 11, 1939.

Describes the application of cement-stabilized earth where bank cutting reached a critical stage on the Rio Grande at Fort Brown, Tex.; grain bags filled with the soil-cement mixture being used for bank revetment.

FINKLE, F. C.

1. The Colorado River silt problem, the dredge "Imperial" and irrigation in Imperial Valley, Cal. Engin. News, vol. 66, no. 24, pp. 695-699, illus., Dec. 14, 1911.

Describing the silt problem of Colorado River and its canals, also giving function and operation of the hydraulic dredge "Imperial." Discusses attempts and failures of diverting the Colorado River and notes effect of silting of canals on diversion and irrigation works. Reports the quantity of material removed by the dredge "Imperial." Construction specifications including cost are given.

FINLEY, G. B.

1. Ditch retards to prevent erosion. Pub. Works, vol. 77, no. 12, pp. 19-20, 35, Dec. 1946.

Discusses the use of ditch retards or baffle dams to prevent ditch erosion, especially those utilizing vegetation.

FINLEY, W. L.

1. Willamette Valley project. Amer. Wildlife, vol. 30, no. 2, pp. 91-94, Mar./Apr. 1941.

Discusses the advantages and disadvantages of the Willamette Valley flood control project. Notes that construction of proposed flood control dams would increase expenses of hop growers since fertilizing silt contained in flood flows would be kept from their lands.

FINNEY, J. H.

1. Forest perpetuation in its relation to Southern water-powers. Mfrs. Rec., vol. 52, no. 25, pp. 83-85, Jan. 2, 1908; [extract], Forestry and Irrig., vol. 14, no. 2, pp. 87-89, Feb. 1908.

Stresses the effects of deforestation upon stream deterioration due to silting, and economic effects of silting upon water-power output and water supply in the Southeast.

FINUCANE, K. J.

1. (and Forman, F. G.). Observations of the load carried by the Swan River during the 1926 flood. Roy. Soc. West. Austral. Jour., vol. 15, pp. 57-61, Apr. 22, 1929.

Gives results of sampling of the Swan and Helena Rivers in western Australia during floods in July 1926.

FIOCK, L. R.

1. Records of silt carried by the Rio Grande and its accumulations in Elephant Butte Reservoir. Amer. Geophys. Union, Trans., vol. 15, pt. 2, pp. 468-473, June 1934.

Describes Rio Grande in relation to its carrying of silt in suspension, drainage area, and variable discharges. Notes that practically all

of silt burden is carried by summer floods from barren, broken central New Mexico portion of basin and from caving of steep high banks. Discusses the determination of silt burden of stream by collection of silt and water samples and their analyses to determine the relative amount of silt being transported, and by conducting silt-surveys in reservoirs where silt deposits have accumulated. Values for net dry weight of a cu. ft. of deposited silt have been determined or assumed for use in computations of volume of silt carried by Rio Grande ranging from 50 to 100 lbs. Historical descriptions of silt and water sampling surveys are given, noting that silt-load depends upon character and source of run-off. Describes reservoir silt-surveys of 1920 and 1925. Notes that average amount of silt transported by Rio Grande into reservoir has been 1.66 percent by volume of total inflow. The mean average amount of silt entering reservoir is approximately 20,000 acre-feet annually. Notes phenomenon of silt underflow which occurred in 7 out of 20 yr. of operation of reservoir. Observations revealed that silt-laden water flows along bottom of lake in thin sheet less than 5-ft. depth and does not diffuse with water already in lake. It retains a temperature higher than that of reservoir water. Effect of discharge of silt-laden water at outlet gates and its characteristics are given. Discusses conditions conducive to silt flow through reservoir. Notes in conclusion the effect of reservoir silt discharges on agriculture and effect of soil erosion control on run-off.

FIPPIN, ELMER O. See also Lyon, T. L., 1.

1. Plant nutrient losses in silt and water in the Tennessee River system. *Soil Sci.*, vol. 60, no. 3, pp. 223-239, Sept. 1945.

Survey undertaken to determine plant nutrient losses in the Tennessee River system. Describes silt sampling and chemical analyses of silt. Suspended silt load data is included.

FISHER, CASSIUS A.

1. Preliminary report on the geology and underground waters of the Roswell artesian area, New Mexico. U. S. Geol. Survey, Water-Supply Paper 158, 29 pp., illus., 1906.

Describes the alluvial area of Pecos Valley. States that fertility of the small flood plains along Hondo, Felix, and Penasco Rivers is high, due to deposits of fine silt brought down from mountain areas, and notes that the fertility of Hondo Valley alluvium exceeds that of the Nile in Egypt.

FISHER, FRED J.

1. Pumping plants and reservoirs. Los Angeles, Calif., Bd. Water and Power Commrs., Ann. Rpt. 36, pp. 30-34, illus., 1937.

Reports operations, maintenance, and construction work of the Pumping Plants and Reservoirs Division, Board of Water and Power Commissioners, Los Angeles, Calif., for the year ending June 30, 1937. Briefly notes the formation of a settling basin at the upper end of the upper Franklin Reservoir to keep sand and silt in flood waters from entering the system.

FISHER, R. A.

1. (and Odén, Sven). The theory of the mechanical analysis of sediments by means of the automatic balance. *Roy. Soc. Edinb., Proc.*, vol. 44, pp. 98-115, illus., 1923-24.

Sets forth the theory of the derivation of the sediment distribution curve and the statistical methods necessary for its deduction from physical data employing the velocity of subsidence as a variable.

FISK, HAROLD N. See also Happ, S. C., 7; Kidwell, A. L., 1; Russell, R. J., 6.

1. Geology of Grant and La Salle Parishes. *La. Geol. Survey, Geol. Bul.* 10, 228 pp., illus., Jan. 1938. Discusses the geology of Grant and La Salle Parishes in Louisiana. Describes the Pleistocene and Recent deposits in the region. Considers meandering and drainage changes. Contains a bibliography of reports concerned with this area.

2. Geological investigation of the alluvial valley of the lower Mississippi River...1 December 1944. 78 pp., illus., tables and plates. Vicksburg, Mississippi River Comm., 1945.

Results of a geological investigation to ascertain the nature and origin of the alluvial valley and to determine the sequence of events in valley evolution. These studies permit the establishment of stages in the development of the Mississippi River system and the differentiation of the major factors which control the behavior of the river. Discusses the following subjects: major characteristics of the valley, nature of the Mississippi entrenched valley system, nature and distribution of the recent alluvium filling, and the characteristics of the alluvial plain. Gives recent history of the valley and discusses the activities of the Mississippi River. The report is well illustrated with figures, tables, and plates.

3. Fine-grained alluvial deposits and their effects on Mississippi River activity. 2 vols. Vicksburg, Miss., U. S. Waterways Expt. Sta., 1947.

A geological investigation of the fine-grained alluvial deposits in the Mississippi Alluvial Valley. Considers the physiographic expression and origin of each type of deposit, giving thickness and location. Suggests mapping the position of fine-grained alluvial deposits by field examinations by aerial photographs, and by the use of borings. Recommends study of previous logs of borings to test the areas mapped. Includes information concerning the physical properties of the fine-grained deposits. Using accurate hydrographic surveys, a study was made to determine the effect of fine-grained deposits on river migration, and the effect of fine-grained sediments on bank caving, channel migration, and on the growth of meander loops, etc. Includes grain-size distribution curves for various types of fine-grained alluvial deposits.

FISKE, HAROLD C.

1. Tennessee River and tributaries, North Carolina, Tennessee, Alabama, and Kentucky—Silt deposits in the Tennessee River. 67th Cong., 2d sess., H. Doc. 319, pp. 189-190, 1922.

Presents results of observations on the extent of silting upon the former low-lying farm lands that were submerged by the Tennessee River waters behind the Hales Bars Dam. Observations considered in connection with possible power development on the upper Tennessee River.

FITZPATRICK, JOHN CLEMENT, ED.

1. The diaries of George Washington, 1748-1799. 4 vols., illus. Boston, Houghton Mifflin Co., 1925. Describes experiments with composts, April 1760 (vol. 1, p. 153) including river sand, mud from the creek, and soil from "Pocoson" [flood plain] of the creek. Mentions experiments with mud from the river, which has been exposed for different lengths of time.

FLAD, EDWARD. See Ockerson, J. A., 4.

FLAD, HENRY.

1. Mississippi River water at St. Louis, 1865. St. Louis, Bd. Water Commrs., Rpt. 1, pp. 43-44, Oct. 1865.

Gives data on suspended load determinations of Mississippi River water at St. Louis for the period June 23 to Aug. 15, 1865, the volume-weight relationship of dried mud, and the rate of settling of suspended sediment.

FLAMANT, M. A. See Hooker, E. H., 1.

FLAXMAN, ELLIOTT M. See also Hathaway, G. A., 1; Hough, J. L., 2, 3; Zwerner, G. A., 2.

1. (and Barnes, Leland H.). Advance report on the sedimentation survey of Ottawa County State Lake, Bennington, Kansas. U. S. Soil Conserv. Serv. SCS-SS-18, 10 pp., illus., Nov. 1937.

Survey was made during the period Mar. 23 to Apr. 13, 1937 of this lake which is used for recreation and which is located on San Creek, 1.3 miles east of Bennington, Kans. Survey revealed that due to silting since its completion in April 1929 7.09 percent of the reservoir capacity had been lost. Average annual depletion in storage capacity is 0.89 percent. Total sedi-

ment deposited in the 1,001 acre-foot reservoir during 8 yr. of operation amounted to 71 acre-feet or an average annual accumulation of 8.88 acre-feet. Includes detailed data pertaining to the engineering features of the dam and reservoir, character of watershed, and the character, distribution, and origin of the sediment in the reservoir. Sediment in Ottawa County Lake has been chiefly derived from sheet erosion. The coarser eroded material has not reached the reservoir but has been deposited on lower slopes and in stream channel above reservoir. The reservoir sediment consists chiefly of the finer material which contains plant nutrients necessary for productive soil. Survey indicates that reservoir will completely fill with sediment in 105 yr. and will have a useful life of approximately 75 yr.

FLEMING, B. P.

1. (and Whitfield, C. J.). Possibilities of vegetative restoration on the Gila. U. S. Soil Erosion Serv., Land, Today and Tomorrow, vol. 2, no. 4, pp. 15-17, illus., Apr. 1934.
Describes conditions of induced accelerated erosion on the watersheds of the Gila and its tributaries due to depletion of vegetative cover resulting from harmful grazing practices. Notes extent of side cutting and bank erosion on main Gila during past 20 yr., and emphasizes the seriousness of rapid depletion of storage capacity of Coolidge Reservoir. Describes investigations on the Gila project to reestablish proper vegetative cover.

2. A nationwide view of essential soil erosion control measures. Agr. Engin., vol. 15, no. 8, pp. 267-272, illus., Aug. 1934.
Discusses flooding of arroyos and effect of the debris on farm lands, on rivers by raising of bed and changing course, and in reservoirs by depleting storage capacity. Notes necessity of stabilizing watershed of the Gila River to check siltation in Coolidge Reservoir. Discusses need for small check dams, terrace outlets, silt barriers, etc. in controlling floods, silting and erosion. Notes fallibility of large control structure. Describes work of U. S. Soil Erosion Service.

FLINN, A. D.

1. (and Weston, R. S., and Bogert, C. L.). Waterworks handbook of design, construction and operation. Ed. 3, 871 pp., illus. New York, McGraw Hill Book Co., Inc., 1927.

A technical handbook on the design, construction, and operation of waterworks. Includes discussion on the silting of reservoirs and the condition and methods of sediment transportation and deposition. Rates of silting in Kensico Lake, N. Y., Beaver Creek Dam, N. C., Loch Raven Reservoir, Md., Zuni Reservoir, N. Mex., reservoir near Carlsbad, N. Mex., Austin Reservoir, Tex., Lake Worth and Elephant Butte Reservoirs, and the La Grange, Sweetwater, Lake Chabot, and Lower Otay Reservoirs in Calif. reported. Considers prevention of deposition, and removal of silt.

FLINT, RICHARD F. See Agar, W. M., 1; Longwell, C. R., 1.

FLORY, EVAN L. See Brown, C. B., 32.

FLUNN, P. J.

1. Irrigation canals and other irrigation works. 283 pp., illus. San Francisco, Calif., [G. Spaulding & Co., printers], 1892.
Deals with the various aspects of irrigation engineering. Includes discussions on the abrad-ing and transporting power of water, methods of excluding undesirable silt from irrigation canals, the fertilizing value of silt, quantity of silt carried by rivers, the improvement of land by the deposition of silt, headworks of irrigation canals, scouring and under sluices, retrogression of levels in irrigation channels, and the use of silt traps or sand boxes for the removal of sand and silt from small channels.

FOLEY, RICHARD. See Keller, N. D., 1.

FOLLANSBEE, ROBERT.

1. (and Dean, H. J.). Water resources of the Rio Grande basin in 1883-1913. U. S. Geol. Survey, Water-Supply Paper 358, 725 pp., illus., 1915.

Presents all data collected previous to Sept. 30, 1913 on flow of the Rio Grande and its tributaries. Includes discussion on silt in the Rio Grande, measurements of silt, and volume-weight relationship of deposited silt. Cites records of silt determinations at El Paso and San Marcial, total silt carried in suspension past San Marcial, and rate of silting in Lake McMillan Reservoir (Pecos River). Notes briefly effect of Pecos River flood of September-October 1904 on conditions of sedimentation near Pecos, Tex.

2. Upper Colorado River and its utilization. U. S. Geol. Survey, Water-Supply Paper 617, 394 pp., illus., 1929.

Presents available data pertaining to the present and future utilization of surface waters of the upper Colorado River basin. Gives results of suspended load determinations in the Colorado River, near Kremmling (Apr. 23, 1905 to May 15, 1906) and near Palisade (Mar. 15, 1905 to Apr. 6, 1906) and in the Gunnison River at Whitewater (Apr. 2 to Oct. 31, 1905). Reports also annual load of suspended matter in the Colorado and Gunnison Rivers. Treats bed-load movement. The abrasive effect of sand contained in mill tailings in upper Canyon Creek upon water wheels in Revenue Tunnel plant is noted.

FOLLETT, W. W. See also Cory, H. T., 2; Mills, A., 1.

1. Forms and constructions of dams and reservoirs. Denver Soc. Civ. Engin., Trans., vol. 1, pp. 67-71, 1890.

Discusses several of the factors to be considered in the selection of suitable reservoir sites for the storage of irrigation waters. Notes that in designing large reservoirs on alluvial streams provisions should be made for the construction of small reservoirs above to act as settling basins and keep the heavier suspended material and bottom load from entering the larger reservoir.

2. Irrigation. Amer. Soc. Civ. Engin., Trans., vol. 62, pp. 22-27, illus., 1909.

Describes engineering works undertaken to provide irrigation waters in the lower Colorado and Rio Grande Valleys. Depicts C. R. Rockwood's scheme of turning arid Salton Desert into fertile land through irrigation "by the Colorado's waters, rich with its fertile silt." Notes the silt conditions at temporary Hanlon heading; describes famous Colorado Crevasse of 1904, and the scouring of Alamo and New River channels. Irrigation in the Rio Grande is discussed; Rio Grande project is described noting proposed construction of the reservoir at Angle, which is provided with space for silt storage and which will deliver silt as well as water to irrigation land.

3. Silt in the Rio Grande. 102 pp., illus. Washington, Internatl. Boundary Comn., U. S. and Mexico, 1913; [abstract], Engin. News, vol. 71, no. 1, pp. 18-21, illus., Jan. 1, 1914.

An illustrated technical report constituting a comprehensive compilation and presenting a discussion of silt determinations on the Rio Grande prior to Jan. 1, 1913. Describes the Rio Grande with particular reference to tributary sources of silt. Tables and an analysis of data are given on the amount of silt passing El Paso (June 1889-Aug. 31, 1890, May 1897-December 1904, and January 1905-May 1910) and San Marcial (1897-1912). Based on suspended silt determinations at San Marcial, the author computes that 315,831 acre-feet of silt would find lodgement in the Engel Reservoir, 40 miles below San Marcial during the 16-yr. period. Takes exception to accuracy of data on sediment carried by Rio Grande (Stabler, H., 3) presented as Appendix B to this report. Notes, in conclusions, variations in the average annual silt content of the Rio Grande making future predictions impossible, and the importance of the silt factor in reservoir construction. Data presented in the report are based on 53 lbs. of dry silt in 1 cu. ft. of mud.

Discussion: E. W. SHAW (Science n. s., vol. 38, no. 981, pp. 554-555, Oct. 17, 1913), quotes Follett on the problem of how much space a given weight of river-borne silt will occupy

when deposited in a reservoir. Takes exception to Follett's statement that deep water affects the compaction of silt. Notes that the one 3-in. cube used by Follett as a basis for determining specific gravity of Rio Grande silt is insufficient data.

FOLSOM, RICHARD G. See Howard, G. W., 1; O'Brien, M. P., 5.

FONTAINE, EDWARD.

1. Contributions to the physical geography of the Mississippi River, and its Delta. *Amer. Geog. Soc., Jour.*, vol. 3, pp. 343-378, 1870-71.

Describes physical characteristics of the Mississippi River and its Delta such as formation of sawyers, sand-bars, islands, and other channel obstructions. Calls attention to caving banks and stream-bank erosion. Notes beginning and growth by deposition of sediment of terraced bottom lands and islands between Memphis and Vicksburg. Discusses turbidity of the Missouri and source of its sediments. The fertility of stream deposited alluvium, and the absence of dissolved matter in water of lower Mississippi is reported.

FOOTE, A. D. See also Dorsey, E. B., 1.

1. Irrigation in Idaho [abstract]. *Engin. News*, vol. 23, no. 17, pp. 391-393, illus., Apr. 26, 1890.

Abstract of report on irrigation and reclamation of desert lands lying between the Snake and Boise Rivers, Idaho. Notes value of silt-bearing waters in increasing the fertility and value of lands previously barren. Notes provisions for scouring sand or gravel coming down river at proposed dam site on the Boise River, and the use of trap to catch small stones and sediment in the irrigation canal.

2. The redemption of the Great Valley of California. *Amer. Soc. Civ. Engin., Trans.*, vol. 66, pp. 229-245, illus., 1910.

Describes the recovery of the Great Valley of California from the menace of floods and soil infertility in order to enhance benefits to navigation, irrigation, mining, and farming interests. Discusses the use of silt as a fertilizing agent and describes the conditions of basin irrigation in Egypt and the proposed basin system of irrigation in the Great Valley of California. Describes the use and operation of barriers in the Feather and Yuba Rivers to arrest the movement of large accumulations of debris and the control of streams in the Valley to permit heavier bottom silt conveyed in flumes to reclaim wastelands (colmatage). The fertilizing value of mine "slickens" in fine river silt is noted.

Discussion: WILLIAM W. HARTS, pp. 246-250, considers the problem of determining the best agricultural treatment for the future of the Sacramento-San Joaquin Valley, Calif. Notes conditions of growth of the low portion of the Valley built up by material washed from surrounding mountains and continually encroaching on Suisan Bay. Criticizes Foote's plan of flood control and adequate drainage facilities, noting the dangers involved due to silting, and states that flood prevention and maintenance of adequately scoured channels can be accomplished by levees. Objects to the use of a barrier system for debris control. H. H. WADSWORTH, pp. 251-256, criticizes various aspects of Foote's paper and discusses briefly the feasibility of the basin method of irrigation. FREDRICK HALL FOWLER, pp. 257-259, considers the feasibility of the basin system of irrigation in the Great Valley of California, and proposes a program for flood control. Notes the inferior quality of sediment transported by rivers of the Great Valley which is due to conditions of erosion and transportation. GEORGE L. DILLMAN, pp. 259-263, comments on the feasibility of Foote's plan of basin irrigation, the value of levee construction in preventing channel silting, and the quality of Sacramento as compared with Nile River silt. Proposes a bypass for the flood waters of the Sacramento and Feather Rivers through the Yolo Basin to Grey's Bend. D. C. HENNY, pp. 269-272, mentions the feasibility of the

barrier system for clarifying flood waters and the application of the principal of undersluicing to a torrential stream. THE AUTHOR, pp. 272-279, comments on previous discussions relative to the effectiveness of barriers in preventing sedimentation in channels in the lower valley sections, and on the comparative navigability of the Sacramento River in 1851 and 1905. Reiterates briefly a description of the operation of the basin method of irrigation and discusses the value of river silt as a fertilizer which will increase the value of land \$10-30 per acre.

FORBES, R. D. See Munns, E. N., 3.

FORBES, R. H.

1. The open-range and the irrigation farmer. *Forester*, vol. 7, pp. 216-219, 254-258, Sept./Oct. 1901.

Describes conditions of overgrazing on ranges of the Southwest, and effects of range mismanagement upon flood, soil erosion and silting conditions. Notes studies to demonstrate methods of reclaiming grazing lands and to suggest means of administration of reclaimed lands.

2. The river-irrigating waters of Arizona, their character and effects. *Ariz. Agr. Expt. Sta. Bul.* 44, pp. 143-214, illus., Sept. 1902.

Discusses quality of waters noting causes of variation in silt and salt content. Describes watershed of Salt, Gila and Colorado Rivers and meteorological conditions. Mountain floodwaters of these rivers are less saline and usually contain less silt than desert floodwaters. Gives proportions of salts during low water noting that amount of sediment during low water is very small. Percentage of sediment by weight given for the Salt, Gila and Colorado Rivers. During years when observations were made it was noted that the silting of reservoirs and ditches was greatest on the Gila River, next greatest on Colorado River and least on the Salt River. Discusses relationship of geological conditions and industrial operation in watersheds to the quantities of sediment available for transportation by flood waters. Reports effect of watershed conditions on color, specific gravity, fineness, flocculence and mineral nature of river sediments. Gives observations on comparison of bulk of mud in flood waters with that of solid sediments noting that mud volumes are subject to slow contraction over long periods of time which may amount to 20 percent or more. Discusses fertilizing value of sediments noting effect of nitrogen and organic matter content. Gives observations on quantity of salts carried per acre-foot of water, character of soluble salts, reactions of alkaline salts on irrigated soils, effect of alkaline salts on crop, plants and trees, method of distributing alkaline accumulations, control of "rise of alkali," and method of removal of excess salt accumulations in sub-irrigated districts.

3. Irrigating sediments and their effects upon crops. *Ariz. Agr. Expt. Sta. Bul.* 53, pp. 59-98, illus., Sept. 20, 1906.

Gives the effect of irrigating sediments and mine tailings carried by the Gila River on various farm crops. Reports amount of sediment carried by the Gila River (at Florence, Ariz.), Salt River (at McDowell, Ariz.), and the Colorado River (at Yuma, Ariz.). Distribution, chemical composition, and fertilizing value of sediment and of mining detritus (on the Gila River at Florence, Ariz.), given. Physical properties of irrigating sediments noted. Field plots maintained to determine effect of silt-blankets on alfalfa yields and certain other crops. Deep cultivation is means of utilizing beneficial sediments and of mitigating the effects of harmful ones. Crop failure by sunburning caused by plastering of vegetation with irrigating mud noted, also plant diseases. Soluble salts in irrigation waters reported. Sediments in irrigating waters controlled by management of grazing ranges. Describes use of settling basins and reservoirs, and emphasizes precautions necessary when pumping from a muddy stream. Sediment in Colorado River at various depths reported.

4. Irrigation in Arizona. U. S. Dept. Agr., Off. Expt. Sta. Bul. 235, 83 pp., illus., June 30, 1911.
Describes various aspects of irrigation in Arizona. Notes agricultural methods employed by various Indian tribes who utilize the sediment deposited on lands after flood flows, and who maintain the fertility of irrigated soils by river-borne sediments. Discusses briefly the conditions of transportation and deposition of sediment in the Colorado River, delta growth annual silt load of the Colorado (1900 and 1904), and the use of the Colorado silt as a fertilizing agency in agricultural operations. Describes conditions of erosion on the Gila River watershed and discusses storage possibilities noting that deposited Gila River sediment, allowed to settle for 1 yr., occupies from 5.2 to 17.4 percent of the original volume of muddy water and that Buttes Reservoir is estimated to fill in 18.6 yr. and the reservoir at San Carlos site in 28.5 yr. Data on the quality of the Colorado, Salt, and Gila River waters are given noting their chemical constituents, sediment content, and irrigating value.
- FOREST SERVICE. See U. S. Forest Service.
- FORESTER, D. M. See also Grover, N. C., 12.
 1. Worst water in the west made fit to drink. Engin. News-Rec., vol. 111, no. 10, pp. 275-279, illus., Sept. 7, 1933.
Reports the use of turbid Colorado River water as the source of drinking water for Boulder City, Nev. Describes water treatment plant, and methods of treatment of silt-laden water. Gives sediment load and chemical characteristics of water. Notes preliminary determination of range of suspended solids from 350 to 59,400 p.p.m., averaging 6,000 p.p.m. for a yearly period. Reached 84,400 p.p.m. on Aug. 27, 1933. Turbidity varied from 15,000 to 150,000 and coefficient of fineness from 0.25 to 1.19.
 2. The desilting works at Imperial Dam. Reclam. Era, vol. 28, no. 8, pp. 152-156, illus., Aug. 1938.
Describes the design of the desilting and appurtenant works, at the Imperial Dam diversion on the Colorado River which will remove 70,000 tons of silt per day thus eliminating its deposition in the All-American Canal system and upon farm lands of the Imperial Valley. Gives data on details of construction of desilting works, extent of silt removal, removal of deposited silt from settling basins by means of rotary type scrapers, system of sludge removal, operation of sluiceway channel, power supply to operate gates of headworks and desilting basins and scraper units, and methods provided for controlling scraper mechanisms.
 3. Desilting works for the All-American Canal. Civ. Engin., vol. 8, no. 10, pp. 649, 652, illus., Oct. 1938.
Describes desilting works for the All-American Canal on the Colorado River. Includes discussion of the economics of silt removal by works. Model studies made for purposes of design of works. Gives detailed description of site, design of desilting works, desilting basins, scrapers for removal of silt, and system of sludge disposal, and reports in detail the operation and control of scraper mechanisms and construction methods. Notes studies on retrogression below Parker and Boulder Dams and states that this work is directed by the U. S. Bureau of Reclamation.
 4. The Imperial Dam, All-American Canal System, Boulder Canyon project. Reclam. Era, vol. 29, no. 2, pp. 28-36, illus., Feb. 1939.
A description of the Imperial Dam, Ariz., and its desilting works.
- FORMAN, F. G. See Finucane, K. J., 1.
- FORSHEY, C. G.
 1. Contributions to the physics of the Gulf of Mexico, and its chief affluent, the Mississippi River. Amer. Assoc. Adv. Sci., Proc. (1877) 26, pp. 134-147, 1878.
Deals with the physics of the Gulf of Mexico and lower Mississippi Rivers, dimensions of the Gulf, drainage of the Mississippi into the Gulf, inlet and outlet of the Gulf, physics of Gulf waters, former boundary of the Gulf, and direction and rate of currents. Includes brief discussion on rate of advance of Delta, and on process of land reclamation.
 2. Physics of the lower Mississippi River. Amer. Assoc. Adv. Sci., Proc. (1877) 26, pp. 148-172, 1878.
Deals with the physical characteristics of the lower Mississippi River. Considers briefly the amount and quality of suspended and bed material transported by the stream, the characteristics of the alluvium surrounding the passes, the limits of dredging in the passes, the action of jetties at the mouths of the passes, and the character of the lower Mississippi River and channels above the passes. The growth and decadence of the passes, conditions of stream erosion, transportation, and deposition, sediment segregation at the mouths of passes due to the effect of saline sea water noted. Gives the character of bottom samples at mouths of passes. Mud lumps and theory of their formation, the geological features of the hydrographic basin of the Gulf, submerged alluvion and bars, and the slope of the delta described.
 3. On the alluvial basin of the Mississippi River styled the Delta. Smithsn. Inst. Misc. Collect., vol. 20, app. 2, pp. 10-18, 1881.
Presents various hydrological data with reference to the alluvial basin of the Mississippi River. Includes discussion of the physics of the stream describing briefly the amount of sediment carried by the stream and its method of transportation.
- FORSLING, C. L. See also Bailey, R. W., 1.
 1. A study of the influence of herbaceous plant cover on surface runoff and soil erosion in relation to grazing on the Wasatch Plateau in Utah. U. S. Dept. Agr. Tech. Bul. no. 220, 72 pp., illus., Mar. 1931.
Presents the results of 15 years' measurements of precipitation, surface runoff, erosion, and sediment losses from two experimental watersheds on the Wasatch Plateau in central Utah. Sediment production by summer rainfall runoff varied more or less directly with the quantity of runoff, although influenced to some extent by size of runoff, trampling of livestock, and dryness of soil when runoff occurred. Results show importance of herbaceous vegetation in reducing runoff and controlling erosion.
- FORSTER, G. W. See Garin, A. N., 1.
- FORTIER, SAMUEL. See also La Rue, E. C., 2.
 1. Transmission losses in unlined irrigation channel. Engin. News, vol. 73, no. 22, pp. 1060-1063, illus., June 3, 1915.
Discusses extent of unlined irrigation canals in the United States, means of transmission losses, results of seepage measurements and factors influencing seepage. Includes one paragraph discussion relative to gradual deposition of silt and noting that silt forms natural lining in canals which is effective in reducing seepage.
 2. (and Scobey, Fred C.). Permissible canal velocities. Amer. Soc. Civ. Engin., Trans., vol. 89, pp. 940-956, 1926; [abstract], Mod. Irrig., vol. 1, no. 5, pp. 30-33, 43, illus., Nov. 1925.
A paper relative to the determination of permissible velocities in canals. Discusses the non-silting and non-scouring velocities as determined by Kennedy and Bellasis; determinations of the transporting power of water by Dubuat and Gilbert; and the differences between laws governing the movement of silt and detritus and those governing the scouring of canal beds. Touches upon the effect of colloids in a stream bed or in water tending to aid in resisting canal erosion. Notes that the presence of electrolyte in water will flocculate colloids and deprive them of the property of cohesion. Describes the types of canal bedding able to withstand scour under high mean velocities, and examines the alteration of canal bed by means of compaction and puddling. Presents a questionnaire on permissible canal velocities submitted by the Special Committee on Irrigation Hydraulics of the American Society of Civil Engineers to various irrigation engineers in the United States. Offers tabulations of re-

sults obtained, and discusses deductions drawn from available data.

Discussion: H. B. MUCKLESTON, pp. 957-958, considers the need for adequate soil determination in order to decide upon the upper limit of permissible canal velocity and differences in the nature of silting and scouring phenomena, notes the effect of silt-laden water in aiding erosion. ELBERT M. CHANDLER, pp. 958-959, notes the necessity of employing velocities somewhat lower than the maximum permissible velocity in order to induce silt deposits to reduce seepage losses as in the case of canals diverting from the Snake River.

ROBERT S. STOCKTON, pp. 959-961, considers conditions of scour at canal curves under permissible velocities for straight courses, and differences in permissible velocities for main canals and secondary small channels. Describes canal design on the Western Section Irrigation Projects of the Canadian Pacific Railway, Department of Natural Resources.

R. A. HART, p. 961, notes the effect of position of the ground-water table on canal seepage because of its effect on the silting-up process, the effect of a high water table on the content of soluble matter in water, and the effect of water temperature on the nature of solubles in water.

R. A. HILL, pp. 961-964, examines the application of Kennedy's formula to the design of American canals. Discusses the relationship between percentage of silt and mean velocity for various depths in canals, and gives data based on measurements on the Colorado River at Yuma gauging station relative to this relationship. JEROME H. FERTIG, pp. 964-965, considers briefly the seasoning of new canals to prevent seepage and scour, and notes the desirability of inducing silt deposits for this purpose. A. WEISS, pp. 965-967, mentions the chief difficulties encountered in the determinations of suitable canal velocities, noting those in the Interstate Canal of the North Platte Project. Results of observations made on the North Platte Project are given. Notes the occasional necessity to decrease velocities thereby inducing silt deposits to stop canal leakage.

CARL ROHWER, pp. 968-971, notes conditions of scouring and silting in the Fort Lyon supply canal, near Rocky Ford, Colo. Notes that the canal carries in suspension large quantities of sand and colloidal silt which at times is deposited on irrigated lands to a depth of as much as 1/4 in. in a single irrigation. Illustrations are given showing the type of silt and the appearance of sand deposits. IVAN E. HOUK, pp. 971-977, considers the problem of non-silting and eroding velocities in a canal with special reference to soil classification. Conditions at Miami River cut-off are described.

THE AUTHORS, pp. 977-984, note the relationship between "permissible velocities" as determined by themselves and Kennedy's "critical velocities," examine the problem of soil classification with special reference to the influence of colloidal material as an aid to canal bed plasticity, and note the necessity for differentiating between non-silting, transporting, and scouring velocities. They review the nomenclature of various soils and comment on previous discussions of their paper.

3. (and Blaney, Harry F.). Silt in the Colorado River and its relation to irrigation. U. S. Dept. Agr. Tech. Bul. 67, 94 pp., illus., Feb. 1928; [abstract], Reclam. Era, vol. 19, no. 6, p. 85, June 1928. Purpose of study to aid irrigators of lower basin for better control of silt and to pave the way for more complete control of silt by storage reservoirs in middle and upper Colorado River system. Describes Colorado River basin. Considers economic remedial measures for silt control by constructing a large reservoir near the lower end of canyon, supplementing it with smaller reservoirs on tributary streams to store silt. Suggests also the use of settling basins and desilting structures at or near intakes of diverting canals, and efficient control

and maintenance of vegetal growth. Gives character of Colorado River silt, which has a normal specific gravity of 2.65, but weight per unit volume varies within wide limits. Notes movement of heavier silt as bed silt on flatter grades below canyon section and of suspended silt of fine texture fairly uniform in size in the lower basin. Describes silt sampling equipment, the physical features of larger tributaries, and gives results of silt determinations for the Green, Upper Colorado, San Juan, Little Colorado, Gila and Salt Rivers. The aggregate quantity of suspended silt in main tributaries supplemented by estimated quantity in smaller tributaries is less than the normal load of suspended and bed silt of Colorado at Yuma, Ariz., indicating the presence of bed silt in tributaries and formation of silt in canyon section. Gives silt content of Colorado at Topock, Ariz. August 1917-July 1918, and Yuma, Ariz., 1903-25. Discusses the silt problem of the lower basin, noting effect of silt on irrigation works and agriculture. Reports silt investigations in the Imperial Valley, silt at canal intakes, distribution of suspended silt in canal systems, 1914, 1917 and 1918, amount of silt carried to irrigated lands, and movement and character of silt in canal beds. Discusses transportation of silt, with reference to R. G. Kennedy's theory, noting that finer silt may be transported long distances in natural or artificial canals if mean velocity of current exceeds 2/3 ft. per sec. with uniformity of silt content throughout vertical section, thus, any practical velocity for an irrigation canal will carry most of finer silt of the Colorado River in suspension. Gives relation between velocity and distribution of silt in canal cross-sections, the relation of velocity and depth to quantity and size of silt transported, and the quantity of silt transported by the Colorado River. Discusses desilting processes in use and notes their inefficiency in the removal of suspended matter. Proposes a proper design for desilting works. Notes inapplicability of formulae on transportation of silt, as used in foreign channels, to water channels of lower Colorado River basin. Discusses determination of silt content of water on a weight basis. The average weight is 62.5 lbs. of dry sediment in 1 cu. ft. of suspended Colorado River silt at Laguna Dam, and dry weight per cubic foot of Colorado River sediment varies widely. Average weight of silt deposited in reservoirs depends on mixture of fine and coarse particles and would not exceed 85 lbs. It is estimated that 137,000 acre-feet of silt is annually transported by the Colorado River to lower end of canyon section. Estimated bed load is 20 percent of total silt load in Colorado River at Yuma, Ariz. Proposes construction of dam in Boulder or Black Canyon that will retain silt and after 100 yr. will have 1/3 of its original water capacity available. There is no evidence to indicate that hydrostatic pressure has any effect on compacting the silt while deposition occurs which would extend the life of a reservoir.

FOSTER, LEO J.

1. All-American Canal gives the answers. Reclam. Era, vol. 31, no. 10, pp. 270-272, illus., Oct. 1941. A summarization of facts relating to the operation of the All-American Canal. Includes brief discussion on means employed to secure fines to seal the All-American Canal. Gives the mechanical analysis of material carried in suspension June 17, 1941, at Station 60 of the canal.
2. Placing the All-American Canal in operation. Civ. Engin., vol. 11, no. 10, pp. 578-583, illus., Oct. 1941. Gives capacity, and reports use made of this canal. Discusses the silt problem, noting use of clay material to prevent seepage.

FOULK, C. W.

1. Industrial water supplies of Ohio. Ohio Geol. Survey, Bul. no. 29, (ser. 4), 406 pp., 1925. Presents results of analyses relative to the quality of the industrial water supplies of Ohio (1898-1902). Data are given on turbidity, degree of sediment content, and dissolved solids content of surface waters.

FOWLER, FREDRICK HALL. See Foote, A. D., 2; Kelly, W., 1; Marx, C. D., 1.

FOWLER, GILBERT J.

1. Water pollution research. *Cur. Sci.*, vol. 8, no. 1, pp. 3-6, Jan. 1939.
Describes the rudimentary requirements of the proposed Water Pollution Research Board, India. Briefly notes findings of a similar board in London, England, relative to the effect of sewage, discharged into the Mersey River, upon conditions of mud and sand deposition in the estuary.

FOX, CHARLES KIRBY. See Stevens, J. C., 6.

FOX, JAMES M. See Lynch, H. B., 1.

FOX, S. WATERS.

1. Technical methods of river improvement as developed on the lower Missouri River, by the general government, from 1876 to 1903. *Amer. Soc. Civ. Engin., Trans.*, vol. 54, pp. 280-326, illus., June 1905.
Deals with engineering methods of improving the lower Missouri River. Describes briefly regimen of stream, character of river-basin conditions of erosion and deposition, character of bed and banks, and effect of floods upon flow. Estimates that the Missouri carries into the Mississippi 400 sq. mile-feet of sediment annually. Emphasizes conditions of stream instability and notes need for improvement. Development of methods and devices used in the improvement of the river, undertaken by the general government, 1876-1903, are described. Discussion: SAMUEL H. YONGE, pp. 327-336, notes the failures and successes of various types of improvements to the Missouri River. Gives a critical analysis of various types of river improvement works. H. M. CHITTENDEN, pp. 336-342, stresses the need for works to maintain navigable depths and serve as bank protection on the Missouri River. A brief criticism of improvement works is given.
L. J. LE CONTE, pp. 342-344, describes observations by the writer on the physical conditions of the Feather and lower Sacramento Rivers in California, and on the phenomenon of bed flow.

FOY, E. R.

1. Weirs and headworks on the Sutlej Valley project and some connected problems. *Punjab Engin. Cong., Minutes of Proc.*, vol. 14, pp. 77-86, illus., 1927.
Describes details of construction of weirs and headworks on the Sutlej Valley project and considers the problem of headworks design to exclude silt from canals.

FRAMJI, K. K.

1. (and Joglekar, D. V., and staff at Khadakvasla). Cause of accretion of river bed at Sukkur Barrage and how to reduce rate of rise [summary]. *Indian Waterways Expt. Sta., Poona, Res. Pub. 11, p. 137, 1947.*
Notes the cause of accretion in the river at Sukkur Barrage. A method for reducing the accretion is proposed.
2. (and Joglekar, D. V., and staff at Khadakvasla). Causes of breaches in River Bunds in Sind and step required to minimize the danger of a recurrence [summary]. *Indian Waterways Expt. Sta., Poona, Res. Pub. 11, p. 133, 1947.*
Comments on causes of breaches in River Bunds and ways to remedy this.
3. (and Joglekar, D. V., and staff at Khadakvasla). Control of sand entering the canals taking off the Lloyd Barrage at Sukkur and other problems relating to the design of the Barrage. *Indian Waterways Expt. Sta., Poona, Res. Pub. 11, pp. 126-127, 1947.*
Lists problems on which model experiments were made in connection with the control of sand entering canals. Problems relating to design of the Barrage are mentioned.
4. (and Joglekar, D. V., and staff at Khadakvasla). Control of sand entering the Mithrao and Khipro canals at Makhi Weir Ex. Nara River (Sind). *Indian Waterways Expt. Sta., Poona, Res. Pub. 11, pp. 127-128, 1947.*
Discusses the problem of excluding sand from canals. Various solutions are suggested and results of efforts to solve the problem are given.

5. (and Joglekar, D. V., and staff at Khadakvasal). Curvative of flow in rivers and canals for controlling sand entering canals and training of tidal and non-tidal waters. *Indian Waterways Expt. Sta., Poona, Res. Pub. 11, p. 125, 1947.*
Comments on curvative flow and the effect on the control of sand entering canals.
6. (and Joglekar, D. V., and staff at Khadakvasla). Design for the Lower Sind Barrage and sand-excluding heads for the two canals of the Dehri-on-Son Anicut (Bihar). *Indian Waterways Expt. Sta., Poona, Res. Pub. 11, p. 127, 1947.*
Comments on the design for the Lower Sind Barrage and sand-excluding heads for the two canals on the Dehri-on-Son Anicut.
7. (and Joglekar, D. V., and staff at Khadakvasla). Design of canals in Sind [summary]. *Indian Waterways Expt. Sta., Poona, Res. Pub. 11, pp. 136-137, 1947.*
A brief review of design of canals in Sind. Formulas for perennial canals are noted.
8. (and Joglekar, D. V., and staff at Khadakvasla). Design of Lower Sind Barrage at Kotri for effective sand exclusion from canals. *Indian Waterways Expt. Sta., Poona, Res. Pub. 11, pp. 98-109, illus., 1947.*
Discusses experiments concerned with exclusion of sand from canals. Scale ratios, time scale, and silt charge scale are given for the Lower Sind Barrage model. Model designs are taken into consideration.
9. (and Joglekar, D. V., and staff at Khadakvasla). Divergence from regime in stable channels in alluvium [summary]. *Indian Waterways Expt. Sta., Poona, Res. Pub. 11, pp. 135-136, 1947.*
Explains the factors causing divergence from regime, since many engineers complained that a large number of stable channels did not agree with the stable channels according to Lacey's formulas.
10. (and Joglekar, D. V., and staff at Khadakvasla). Emergent measures for preventing serious damage to the central sluices of the Mahanadi Anicut at Cuttack-Orissa. *Indian Waterways Expt. Sta., Poona, Res. Pub. 11, pp. 27-37, illus., 1947.*
Reviews measures suggested for scour protection. Causes of trouble are noted. Describes model experiments and results.
11. (and Joglekar, D. V., and staff at Khadakvasla). Factors determining the size and shape of river meanders. *Indian Waterways Expt. Sta., Poona, Res. Pub. 11, p. 131, 1947.*
Various factors which determine the size and shape of river meanders are discussed. Cause of meandering is mentioned.
12. (and Joglekar, D. V., and staff at Khadakvasla). Flattening the slope of the N. W. Canal-Sind. *Indian Waterways Expt. Sta., Poona, Res. Pub. 11, pp. 85-86, 1947.*
Discusses the flattening of this slope of the N. W. Canal in order to retard the deterioration in water levels of the Indus River above the Sukkur Barrage.
13. (and Joglekar, D. V., and staff at Khadakvasla). Floods in the Damodar River and their control [summary]. *Indian Waterways Expt. Sta., Poona, Res. Pub. 11, pp. 133-134, 1947.*
Comments on the floods in the Damodar River. Various remedies are suggested to bring the Damodar under complete control.
14. (and Joglekar, D. V., and staff at Khadakvasla). Measures adopted to reduce turbulence in the Hooghly River downstream of the knuckle at the Titaghar Jute Mill (Bengal). *Indian Waterways Expt. Sta., Poona, Res. Pub. 11, pp. 38-42, illus., 1947.*
Comments on experiments carried out with 1/300:1/60 scale model and 1/150:1/80 part model of the Hooghly River. Objectives are to investigate the present conditions downstream of the knuckle, to see if accretion can be induced downstream of the knuckle by means of piles. Pitched "attracting" islands were placed so as to attract the flow towards the opposite right bank, thus reducing turbulence in the knuckle.
15. (and Joglekar, D. V., and staff at Khadakvasla). Model limitations as regards bank erosion and accretion upstream and downstream of a tree grove. *Indian Waterways Expt. Sta., Poona, Res. Pub. 11, pp. 5-6, 1947.*

- Explains some limitations in regard to bank erosion and accretion upstream and downstream of a tree groyne in the case of the model of the River Suttlej at Samasata.
16. (and Joglekar, D. V., and staff at Khadakvasla). Optimum shape of the nose of Central Island at Kotri for the Lower Sind Barrage. Indian Waterways Expt. Sta., Poona, Res. Pub. 11, pp. 110-113, illus., 1947.

Comments on model experiments undertaken to evolve the best shape of Central Island which would give the minimum depth and extent of scour and would thus cause less concentration of flow and less turbulence at the nose.
17. (and Joglekar, D. V., and staff at Khadakvasla). Our present knowledge regarding the factors affecting silting and scouring of channels [summary]. Indian Waterways Expt. Sta., Poona, Res. Pub. 11, p. 132, 1947.

Comments on factors concerned with silting and scouring of channels.
18. (and Joglekar, D. V., and staff at Khadakvasla). Preventing erosion along the foreshore of the Hooghly River above Calcutta—Tide producing apparatus. Indian Waterways Expt. Sta., Poona, Res. Pub. 11, pp. 130-131, 1947.

Summarizes work done in preventing erosion along the foreshore of the Hooghly River above Calcutta.
19. (and Joglekar, D. V., and staff at Khadakvasla). Prevention of further erosion of the left bank of the Rupnarayan River above Kolaghat railway bridge of the B. N. Railway. Indian Waterways Expt. Sta., Poona, Res. Pub. 11, p. 130, 1947.

Summarizes the experiments undertaken to solve the problem of preventing further erosion of the left bank of the Rupnarayan River and gives results.
20. (and Joglekar, D. V., and staff at Khadakvasla). Prevention of scour below the central sluices of the Mahanadi Anicut at Cuttack (Orissa). Indian Waterways Expt. Sta., Poona, Res. Pub. 11, p. 5, illus., 1947.

Shows the success obtained in preventing scour below the central sluices of the Mahanadi Anicut based on field results after model experiments.
21. (and Joglekar, D. V., and staff at Khadakvasla). Proposed railway bridge across the Ramganga River on the proposed C. K. Railway (a branch of E. I. Railway). Indian Waterways Expt. Sta., Poona, Res. Pub. 11, pp. 6-17, illus., 1947.

Discusses minimum distance needed between the river's edge and the proposed railway embankments. Estimates flood damage and depth of scour. Meander loops of the river are studied. Various formulas are given. The required guide bank to keep off the worst theoretical meander is discussed.
22. (and Joglekar, D. V., and staff at Khadakvasla). Protecting the foreshore of the Anglo India Jute Mill on the Hooghly River (Bengal). Indian Waterways Expt. Sta., Poona, Res. Pub. 11, pp. 42-44, 1947.

Describes methods of protection and shows banks where erosion was taking place. Recommendations are made.
23. (and Joglekar, D. V., and staff at Khadakvasla). Rapid westerly movement of the Kosi River [summary]. Indian Waterways Expt. Sta., Poona, Res. Pub. 11, pp. 132-133, 1947.

Discusses westerly movement of Kosi River due to the excessive quantity of sand carried down from the mountains of Nepal.
24. (and Joglekar, D. V., and staff at Khadakvasla). Rate of sand attrition in channels. Indian Waterways Expt. Sta., Poona, Res. Pub. 11, pp. 115-119, illus., 1947.

Discusses an experiment, first started in September 1938, to determine how far attrition was the true explanation of the progressive reduction of size of bed materials from the hills to the sea. A circular tank was used in which water was revolved with a uniform velocity.
25. (and Joglekar, D. V., and staff at Khadakvasla). Redistribution of sand load between the Mahanadi and Katjuri system at Cuttack (Orissa). Indian Waterways Expt. Sta., Poona, Res. Pub. 11, pp. 44-52, illus., 1947.

Describes model experiments concerning the redistribution of sand load between the Mahanadi and Katjuri system at Cuttack.
26. (and Joglekar, D. V., and staff at Khadakvasla). The Rupnarayan River upstream of the goods yard, Kolaghat railway station (upstream of the B. N. railway bridge)—Measures to reduce risk of attack on the right bank of. Indian Waterways Expt. Sta., Poona, Res. Pub. 11, p. 78, illus., 1947.

A pilot model was used to study river conditions. Recommends the use of tree groynes to protect the river bank.
27. (and Joglekar, D. V., and staff at Khadakvasla). Safeguarding the Hardinge bridge over the Ganges (Bengal-Assam Railway) against the danger of being outflanked. Indian Waterways Expt. Sta., Poona, Res. Pub. 11, pp. 128-130, 1947.

The problem of the safeguarding the Hardinge bridge is discussed and various remedial measures are suggested. Falling aprons and the scour round bridge piers are mentioned.
28. (and Joglekar, D. V., and staff at Khadakvasla). Scour downstream of rigid structures in wide channels—Prototype data regarding depth of scour downstream of bridges. Indian Waterways Expt. Sta., Poona, Res. Pub. 11, pp. 114-115, illus., 1947.

Points out the problem of scour downstream of bridges. Lists 21 bridges on alluvial rivers on the North Western Railway, of which data concerning scour has been observed.
29. (and Joglekar, D. V., and staff at Khadakvasla). Training of rivers with permeable tree groynes. Indian Waterways Expt. Sta., Poona, Res. Pub. 11, pp. 79-85, illus., 1947.

Discusses use and type of tree groynes used for river training in the Sind. Gives diagrams of the use of tree groynes and describes construction of tree groynes.
30. (and Joglekar, D. V., and staff at Khadakvasla). Training of the Jumna River at Delhi Gate pump house by means of a pitched embankment—Delhi. Indian Waterways Expt. Sta., Poona, Res. Pub. 11, pp. 60-64, illus., 1947.

Discusses the training of the Jumna River by means of a pitched embankment.
31. (and Joglekar, D. V., and staff at Khadakvasla). Training of the Malaprabha River to protect the left abutment of the M. and S. M. Railway bridge No. 8 at Hole Alur on the Hotgi-Gadag Line, Bombay. Indian Waterways Expt. Sta., Poona, Res. Pub. 11, p. 5, illus., 1947.

Shows that field results after model experiments were satisfactory for the problem of preventing an erosion near a railway bridge.
32. (and Joglekar, D. V., and staff at Khadakvasla). Training the Luni River at railway bridge No. 3 of the Samardi-Raniwara Branch of the Jodhpur Railway. Experiments in connection with the—. Indian Waterways Expt. Sta., Poona, Res. Pub. 11, pp. 52-60, illus., 1947.

Describes model experiments in training the Luni River at a railway bridge.
33. (and Joglekar, D. V., and staff at Khadakvasla). Training the River Indus above the Sukkar Barrage to prevent slips of the right bank below the nose of the approach channel. Indian Waterways Expt. Sta., Poona, Res. Pub. 11, pp. 17-27, illus., 1947.

Describes model experiments to determine how to reduce the concentration of flow at the nose and the depth of scour inside the approach channel, for the purpose of establishing forward flow throughout the approach channel, preventing slipping of the right guide bank, and improving sand exclusion at the entrance to the approach channel.
34. (and Joglekar, D. V., and staff at Khadakvasla). Training the Suttlej River at Samasata, about 6 miles downstream of the Empress Bridge at Adamwahan, N. W. Railway. Indian Waterways Expt. Sta., Poona, Res. Pub. 11, pp. 68-78, illus., 1947.

Describes experiments to stabilize the river course upstream and downstream of the bridge. Models were used in some of the experiments. Recommendations are made.
35. (and Joglekar, D. V., and staff at Khadakvasla). Training the Watrak River at Kaira—Bombay. Indian Waterways Expt. Sta., Poona, Res. Pub. 11, pp. 64-67, illus., 1947.

- Discusses training the Watrak River at Kaira so as to prevent further bank erosion. Methods of prevention of erosion are discussed. Instructions and designs for tree groynes and timber pile groynes are given.
36. (and Joglekar, D. V., and staff at Khadakvasla). Apron design for the south guide bank of the Alexandra Bridge on the Chenab (N. W. Railway). India. Cent. Waterways, Irrig. and Navigation Res. Sta., Poona, Res. Pub. 12, p. 65, illus., 1948. Discusses an apron design to prevent scour on the south guide bank of the Alexandra Bridge on the Chenab River at the Alexandra Bridge, N. W. Railway.
 37. (and Joglekar, D. V., and staff at Khadakvasla). Comparison of sand-exclusion at the nose of the outer bank and at the raised sill of the approach channel under present conditions and with outer bank extended to position Q—Experiments in 1/80:1/40 part-width, Sukkur Barrage model. India. Cent. Waterways, Irrig. and Navigation Res. Sta., Poona, Res. Pub. 12, pp. 177-178, illus., 1948. Describes model experiments carried out to test the effect of the extended bank on sand exclusion. Concludes that, with the extension of the outer bank, the deep scour-hole near the nose in the approach channel will accrete, and slips in the right bank will be prevented. Sand exclusion at the nose and at the raised sill will be improved.
 38. (and Joglekar, D. V., and staff at Khadakvasla). Comparative analysis of sand by Puri sand meter and air sand meter. India. Cent. Waterways, Irrig. and Navigation Res. Sta., Poona, Res. Pub. 12, pp. 26-33, illus., 1948. Discusses experiments dealing with the comparative analysis of sand by the Puri sand meter and the air sand meter. Describes the air sand meter as designed and prepared by the Central Irrigation and Navigation Research Station, Poona, and methods of calculation and graphical representation.
 39. (and Joglekar, D. V.). Effect of change in regulation operations of the right pocket of the Sukkur Barrage on sand exclusion—experiments in 1/80:1/40 part-width Sukkur Barrage model. India. Cent. Waterways, Irrig. and Navigation Res. Sta., Poona, Res. Pub. 12, pp. 179-186, illus., 1948. Describes model experiments to compare sand exclusion at the raised sill of the offtake into the right pocket under existing regulation operations and under those suggested by the executive engineer.
 40. (and Joglekar, D. V., and staff at Khadakvasla). Measures for arresting bank erosion near Bhadel and Bhagda villages on Auranga River—Bombay. India. Cent. Waterways, Irrig. and Navigation Res. Sta., Poona, Res. Pub. 12, p. 51, illus., 1948. Gives various recommendations for arresting bank erosion near Bhadel and Bhagda villages on Auranga River, Bombay.
 41. (and Joglekar, D. V., and staff at Khadakvasla). Mid-season scouring operations of the right pocket of Sukkur Barrage, Sind. India. Cent. Waterways, Irrig. and Navigation Res. Sta., Poona, Res. Pub. 12, pp. 61-64, illus., 1948. Discusses the proposal for additional scouring operations of the right pocket of Sukkur Barrage in order to keep the pocket clear and provide a silt trap so that silt can be deposited instead of being carried into the canals.
 42. (and Joglekar, D. V., and staff at Khadakvasla). Proposed design of Lower Sind Barrage at Kotri for effective sand exclusion from canals, Sind. India. Cent. Waterways, Irrig. and Navigation Res. Pub. 12, pp. 116-133, illus., 1948. Deals with model experiments to determine features in the design of the barrage for effective sand exclusion from canals.
 43. (and Joglekar, D. V., and staff at Khadakvasla). Protection of the left bank of the Katjuri River at Khannagar upstream of the Katjuri Railway Bridge—Orissa. India. Cent. Waterways, Irrig. and Navigation Res. Sta., Poona, Res. Pub. 12, pp. 43-45, illus., 1948. Describes model test and results for the protection of the left bank of the Katjuri River at Khannagar upstream of the Katjuri Railway Bridge, Orissa. Concludes that the model only gives an indication of the accretion below a spur. Points out that to avert danger to the left embankment, the spur should be 1200 ft.
 44. (and Joglekar, D. V., and staff at Khadakvasla). Protecting the right bank of the Kuakhai River above the B. N. Railway bridge near Cuttack, Orissa. India. Cent. Waterways, Irrig. and Navigation Res. Sta., Poona, Res. Pub. 12, pp. 39-42, illus., 1948. Describes model experiments to determine works to protect the right bank of the Kuakhai River above the B. N. Railway bridge near Cuttack, Orissa. Concludes that erosion is due to curved flow and is accentuated by the stone pitching. Suggests a guide bank as a promising measure.
 45. Scour below wiers. India. Cent. Waterways, Irrig. and Navigation Res. Sta., Poona, Res. Pub. 12, pp. 67-82, illus., 1948. Analyzes prototype and model data of depths of scour below wiers and their ancillary works in order to have a rational basis for the design of apron protection. Comments on two model investigations: one for scour below a bridge over the Ganga and another for scour below a barrage on the Indus. Notes the need for more prototype data in relation to results of model tests and independent basic experiments concerned with scour.
 46. (and Joglekar, D. V., and staff at Khadakvasla). Training the Tapti River at Surat (Bombay). India. Cent. Waterways, Irrig. and Navigation Res. Sta., Poona, Res. Pub. 12, pp. 54-60, illus., 1948. Describes model experiments for solving problems concerned with the training of the Tapti River at Surat, Bombay. The main problems to be solved were to arrest the erosion on the right bank upstream of the Hope Bridge and the attack on the city walls on the left bank downstream, to determine the best site for the Pump House, and to prevent further loss of fertile lands in the Bhatyur embankment.
- FRANK, BERNARD.**
1. Headwater highways; a new forest menace. Jour. Forestry, vol. 39, no. 3, pp. 291-296, Mar. 1941. Deals with the damaging effects of improper highway construction in headwater areas. In the Great Smoky Mountains construction of the Sky-line Drive caused excessive deterioration of the bordering forest. Road construction in the Pisgah National Forest caused the filling up with debris of Lookingglass Creek destroying the hemlock bottom below Lookingglass Falls. Sand deposits in the stream ruined it completely for fishing. The Yellow Gap forest road is destroying the fishing in South Mills River, and silt and debris have found their way into streams of North Carolina due to conditions of erosion resulting from the construction of the Blue Ridge and other major highways. Debris movement from slopes along the Angeles Crest Highway and other mountain roads in Southern California averages 125,000 cu. yd. per mile, and the capacity of Devils Gate Reservoir has been reduced 11 percent in 14 yr. Studies of reservoir siltation in San Francisco Peninsula indicate that highway construction is the major cause of sedimentation. Mud and boulder movements on slopes weakened by road cuts in other areas are noted.
 2. Sedimentation program of the Department of Agriculture. Fed. Inter-Agency Sedimentation Conf., Denver, 1947, Proc., pp. 49-51, 1948. Gives a broad picture of the reclamation program carried on by the U. S. Soil Conservation Service and Forest Service. Describes the program of research.
- FRASER, HORACE J.**
1. An experimental study of varve deposition. Roy. Soc. Canada, Proc. and Trans., vol. 23, sec. 4, pp. 49-60, illus., May 1929. Describes experiments to determine relative values of some factors affecting the formation of varved glacial clay, also experiments on the settling of various sized sand, silt, and clay particles, and on varved clay under different temperature conditions. The deposition of clay under fixed temperature, and on flocculation at

low temperatures noted. Discusses application of the results of experiments and conditions essential for formation of diatatic varves.

2. Sampling incoherent sands for porosity determinations. *Amer. Jour. Sci.*, (ser. 5), vol. 22, no. 127, pp. 9-17, July 1931.

Describes methods of obtaining representative samples of incoherent sands from which accurate determinations of porosity, apparent density of samples, and actual specific gravity of the component grains may be made. Laboratory procedure for porosity determinations is described.

3. Experimental study of the porosity and permeability of clastic sediments. *Jour. Geol.*, vol. 43, pp. 910-1010, illus., Nov./Dec. 1935.

Presents results of a study dealing with (1) the experimental evaluation of the several factors which control the porosity and permeability of ideal clastic sediments, (2) the determination of the modifications produced in natural deposits by variations from the ideal, and (3) the application of the principles of permeability to the problem of the distribution and localization of mineral deposits in clastic sediments. The effect upon porosity of the factors: grain size, shape of grain, method of deposition, and compaction are experimentally determined for ideal clastic sediments and comparison is made with those of river and beach sands and other clastic material. Discusses various equations for permeability, the controlling factors that are experimentally evaluated for ideal clastic material and the modifications produced by variations from the ideal in natural deposits. Observations made on the effects of wave and river depositional processes on porosity and permeability are presented. Compares the relative permeability of various unconsolidated sediments. Outlines changes produced in original porosity and permeability of clastic material by compaction, cementation, and recrystallization. Application is made of principles governing flow of fluids through unconsolidated clastic material to the flow of hydrothermal solutions through rocks of clastic origin.

FRASER, T. See Sisler, J. D., 1.

FRAZIER, A. H.

1. New type of silt sampler developed for water studies. *Engin. News-Rec.*, vol. 111, no. 17, p. 491, illus., Oct. 26, 1933.

Silt sampler for determining quantity of silt carried by surface streams consists of a pint milk bottle held in streamlined bronze weight. This sampler may be used anywhere in cross-section of stream to a depth within less than one foot of stream bottom.

FREE, E. E.

1. A possible error in the estimates of the rate of geologic denudation. *Science n. s.*, vol. 29, no. 741, pp. 423-424, Mar. 12, 1909.

Estimates of rate of denudation made by Dole and Stabler from examination of river waters and based upon the assumption that all material removed from land to sea is carried in suspension or solution by outward-flowing water. Studies of magnitude of aeolian transport cast doubt on validity of this assumption. Udden calculated that transport capacity of winds blowing outward from the Mississippi basin is at least 1,000 times greater than that of the river but the actual amount of material moved is comparatively small. Author believes that present estimates of rapidity of denudation are far too low.

2. The phenomena of flocculation and deflocculation. *Franklin Inst. Jour.*, vol. 169, no. 6, pp. 421-438, illus., June 1910.

Summarizes present knowledge of flocculation phenomena as they affect suspension and as they are affected by various external conditions, mainly the presence or absence of soluble salts, acids, and alkalies.

FREEMAN, DELBERT B.

1. River navigation extended by open-channel expedients—Part V. Navigation channels developed by contraction works. *Civ. Engin.*, vol. 16, no. 11, pp. 493-494, illus., Nov. 1946.

Describes contraction of the channel in the Missouri River to develop navigation channels. Notes use of revetments to stabilize concave banks.

FREEMAN, JOHN R. See also Ripley, H. C., 1.

1. (and Stearns, Frederick P.). Report on the enlargement and improvement of the Baltimore [Md.] water supply. 209 pp., Mar. 25, 1910.

Describes and discusses proposed plan. Includes discussion on deposits of silt in reservoirs and on complications caused by muddy water which affect the construction of a proposed large storage reservoir on the Gunpowder River above Loch Raven. Presents data on rates of silting in Loch Raven, 1881-1908 and in Lake Roland on the estimated basis of deposits for 50 yr. Reports amount of material dredged from these reservoirs, and an estimated amount of silt going over these dams. Estimates the quantity of silt which would deposit annually in proposed large reservoir on the Gunpowder River, and advocates inexpensive measures to prevent silt from entering the proposed reservoir. The cause, extent, and persistence of the turbidity of the Gunpowder River presented.

2. Flood problems in China. *Amer. Soc. Civ. Engin., Trans.*, vol. 85, pp. 1405-1460, illus., 1922.

Discusses river training and flood control in China, the concentration of floods, reforestation, and ancient Chinese methods of flood protection. The problems of the Yellow River are considered with particular reference to some noteworthy outbreaks of this river noting conditions of scour, the transportation and deposition of sediment, and characteristics of Yellow River silt. Considers a method of river training for protection against floods. Flood problems of the Yang-tse, Chihli and Huai Rivers along similar lines are discussed.

Discussion: C. M. TOWNSEND, pp. 1548-1552, compares hydraulic characteristics of the Yellow and Missouri Rivers, briefly noting comparative data on sediment content. Comments on the effect of levees on the rise of the bed of the Yellow and Mississippi Rivers, the effect of other factors such as bank caving and reforestation on the sediment content of streams, and on bank protection works. The discussion includes reference to streams in the United States and in foreign countries. THOMAS H. WIGGIN, pp. 1553-1558, notes methods and cost of completing outer dikes along the Yellow River, the benefit to crops from floods, and the necessity of considering irrigation in any flood-control system. Outlines phenomena governing the change in course of the Yellow River and the tendency of the stream to raise its bed about 3 ft. per 100 yr. Describes Freeman's proposal of a narrow initial channel for the Huai River, depending on floods to deepen it. Notes the prevalence of silt in Chinese rivers, the tendency of reservoirs to fill up quickly, and possible remedies. Commends the agricultural utilization of muddy flood waters by the Chinese.

3. The need of a national hydraulic laboratory for the solution of river problems. *Amer. Soc. Civ. Engin., Trans.*, vol. 87, pp. 1033-1097, illus., 1924.

Proposes the establishment of a national hydraulic laboratory for the solution of problems related to river control in the United States, with special reference to the Mississippi River. Practical problems involve forms of structures to prevent stream beds and banks from erosion. Describes proposed laboratory, including a suggested list of studies. Scope, procedure, and economy of model studies are discussed. Reviews hydraulic laboratory research in foreign countries. Summarizes available data on river control and training works.

Discussion: B. F. GROAT, pp. 1143-1147, gives results of laboratory experiments to show that tests on models can lead to accurate conclusions as to prototype behavior. Mentions magnitude of problems created by ice jams and those created by the immense deposition of material at the mouth of the Mississippi. Suggests that the trifling cost of a national hydraulic

- lic laboratory would be well justified as the foundation of an agency to study these problems. HARDY CROSS, pp. 1147-1150, notes the prospective value of this laboratory to irrigation and drainage, bridge and railway engineering, power development, and flood protection. Points out the close connection of the fundamental problems of sedimentation with those of molecular physics, noting that this connection can best be made in a laboratory. GARDNER S. WILLIAMS, pp. 1154-1155, considers the fundamentals of normal scour and deposition in flowing stream noting that data is needed on the effect of local disturbances, such as eddies, rapids, wind, barometric effects, and character of border material. Decides that solution of problems requires accurate and controlled experimentation in an especially constructed laboratory for river hydraulics. E. J. DENT, pp. 1156-1163, notes distortions in relative values when using models to design river control works. Cites cases of contraction, bank protection and other works on the Mississippi River. Observed conditions of stream scour, silt transportation and deposition. Compares amount of sediment carried by the Yellow and Mississippi Rivers during flood. Reports that the heaviest load observed at New Orleans for several years was about 0.27 percent. H. F. DUNHAM, pp. 1164-1166, suggests testing merits of proposed model studies by observing laws governing flow and deposition. F. E. MATTHES, pp. 1167-1172, reports the utility of laboratory studies observing that pre-war experiments in Germany demonstrated the possibility of determining the fundamental laws of stream flow and channel building. Emphasizes the inherent physiographic nature of the main problems presented by the Mississippi. Concludes that investigators should have at their disposal the facilities of a specially designed laboratory. HUBERT ENGELS, pp. 1172-1176, considers the results of previous experiments to determine the scientific and technical value of laboratory work. Mentions early model studies by M. Fargue, Osborne Reynolds, and others. Lists own experiments and notes the practicability and economy involved in hydraulic laboratory research. EDWARD BURR, pp. 1176-1179, considers the control and improvement of large alluvial rivers particularly the Mississippi, illustrating the difference between conditions in the laboratory and in the field. Observes that only by utmost cooperation and appreciation of the field conditions can the laboratory help to solve the construction problems of an intensely practical character.
4. Taming the Mississippi. Assoc. Chinese and Amer. Engin. Jour., vol. 8, no. 8, pp. 1-9, illus.; no. 9, pp. 28-36, Aug.-Sept. 1927.
Discusses employed and proposed methods of training the Mississippi River to prevent floods and to transport its burden of sediment to the sea. Notes effectiveness of levees and bank revetment works. Practicability of reforestation, use of reservoirs at headwaters, detention reservoirs in basins below Cairo, and spillways are briefly considered. Discusses bed-load movement and characteristics of bed material. Proposes river straightening and notes necessity for hydraulic laboratory study of problems of river and harbor development and problem of sediment control.
 5. European river- and harbor-laboratories revisited. Engin. News-Rec., vol. 99, no. 22, pp. 873-875, Dec. 1, 1927.
A report on work being undertaken at leading European hydraulic laboratories of the "flussbau" or "river and harbor" type. Work at Karlsruhe, Charlottenburg, Potsdam, Dresden, Damstadt, Hannover, Wilhelmshafen, and Bremerhafen, Germany, Stra, Italy, Zurich, Switzerland, and Danzig are noted. Model testing is discussed and application to specific erosion, degradation, stream, and sedimentation problems noted.
 6. Flood control on the River Po in Italy. Amer. Soc. Civ. Engin., Proc., vol. 54, no. 4, pp. 957-992, illus., Apr. 1928; [abstract], Engin. and Contract., vol. 67, no. 5, pp. 265-268, illus., May 1928.
Discusses flood control works on the River Po, Italy. Describes the drainage area of the Po, meteorological and flood conditions, stream runoff, turbidity measurements taken during 1917, and conditions of delta extension. Outlines the system of dikes in the valley of the Po and compares it with that of the Mississippi. Briefly portrays the Po River channel dredging for navigation purposes; river training and bank protection by facine and rip-rap revetment and training walls; bank building by sediment deposits between the river channel and dikes, adding to cultivable land; and construction of navigation locks and jetties at the river's mouth.
 7. (editor). Hydraulic laboratory practice. 868 pp., illus. New York, Amer. Soc. Mech. Engin., 1929.
A comprehensive work dealing with the work and problems of experimental hydraulic laboratories in Europe and America. Includes descriptions and plans of those in Europe. Comments on sediment movement, meandering, erosion below dams, distribution of sediment in branching streams, prevention of scour, and sediment movement at dams. Includes biographies and lists the publications of the following hydraulic research workers: Schoklitsch, Corstanjen, Fellenius, Krey, Möller, Engels, Timonoff, and Rehbock.
- FRETZ, HENRY A.
1. The burden of Lehigh River in one year. Pa. Acad. Sci., Proc., vol. 8, pp. 92-94, 1934.
Observations on the burden of the Lehigh River during 1927 reveal that the total content of dissolved and solid material amounted to 97,890 tons, and the total material removed from entire watershed amounted to 247 lbs. per acre. Gives table of variations for soluble, insoluble, and total burdens, gauge readings, discharge, and tonnage transported daily. Tabulation of burden for river stages, and sources of soluble burden are noted.
- FREUDENTHAL, L. E.
1. Flood and erosion control as possible unemployment relief measures. Science n. s., vol. 78, no. 2029, pp. 445-449, Nov. 17, 1933.
Discusses the possible use of unemployed labor in the application of flood and erosion control measures. Quotes H. H. Bennett on the extent of the annual removal of plant flood elements due to erosion in the United States. Flood control measures are desirable for the control of sedimentation transportation and deposition in streams. Suggests use of small check dams or earth-filled sacks in small gullies to check sediment transportation and promote native vegetation. Gives results of his experience on a farm near Dona Ana, N. Mex.
- FRIEDKIN, J. F.
1. A laboratory study of the meandering of alluvial rivers. 40 pp., illus. Vicksburg, Miss., U. S. Waterways Expt. Sta., 1945.
Gives the results of laboratory tests of stream meandering conducted with small-scale rivers. Part 1 is devoted to a discussion of the basic principles of meandering and contains the results of tests and analyses on the causes of meandering and the development of the meandering pattern under variable conditions of the discharge and hydraulic properties of the channel. Reports also the amount of sand transported and the rate of bank erosion. Part 2 presents the principles involved relative to the effects on bank stabilization of meandering and includes the results of tests to determine whether bank stabilization on a stream should progress downstream or upstream. Part 3 is a discussion of the laboratory technique developed for these studies and includes descriptions of the general testing methods, measuring devices, and materials used.
 2. River navigation extended by open-channel expedients—Pt. 3, Alinement affects length, depth, and stability of channel. Civ. Engin., vol. 16, no. 11, pp. 491-492, illus., Nov. 1946.
Comments on meandering alinement and its effects, and notes an ideal alinement for an alluvial river. Notes that alinement is divided into three types. Comments on alinement on the lower Mississippi.

FRISTOE, R. E.

1. (and others). Describe different types of bulkheads, jetties and seawalls, giving cross-sections of each and stating the purpose which they serve, including comparisons of first cost, service life and maintenance cost of the various types. Assoc. Chinese and Amer. Engin., Jour., vol. 13, no. 1, pp. 31-36, Jan. 1932.

W. L. Morse, W. J. Backes, R. J. Middleton, G. A. Rodman, E. H. Roth, W. C. Swartout, and W. G. Brown, joint authors.

Includes eight paragraphs noting the efficiency of two single lines of jetties at Mare Island to prevent tidal currents from carrying, into the Navy Yard, silt from the Sacramento and San Joaquin Rivers.

FRIZELL, J. P.

1. Note on the power of running water to hold matter in suspension. Franklin Inst. Jour., vol. 106, no. 3, pp. 177-180, illus., Sept. 1878.

Comments on articles relative to the suspension of solids in flowing water (Herschel, C., 1). Shows contradiction in M. Dupit's theory that power of suspension depends directly upon relative velocity of filaments. Discusses, in this connection, the settling velocities of spherical masses and the effect of gyratory movements (eddies) on the power of water to hold material in suspension.

FRONTINUS, SEXTUS JULIUS.

1. The two books on the water supply of the city of Rome A. D. 97;...also a translation into English, and explanatory chapters by Clemens Herschel. 296 pp. Boston, D. Estes & Co., 1899.

A treatise on the water-supply system of Rome during the reign of the Caesars, which includes a brief description of the sedimentation basin used to reduce the sediment content above the intake of New Anio (pp. 19, 63).

FROSINI, PIETRO.

1. Contributi italiani allo studio del trasporto solido nei corsi d'acqua (Italian contribution on the study of the sediment load in streams). Internatl. Geod. and Geophys. Union, Sect. for Sci. Hydrol. Bul. 21, pp. 59-80, 1934. In Italian. Translation on file at the U. S. Soil Conservation Service, Washington, D. C.

Presents the results of sediment-load determinations made on the Tiber River and compares the results with recent theoretical investigations on sediment load in streams made by L. Conti of the Royal Engineering School of Rome.

FROUHET, FELIX.

1. Carriage of alluvium by water courses. Engin. and Contract., vol. 49, no. 22, pp. 522-525, May 29, 1918.

Presents extracts from a study made by M. L. W. Collet, Mellet and Stumf, which was published in the Annales Suisses d'Hydrographie. Discusses such subjects as determination of amount of suspended matter; bearing of hydrographic data on determination of suspended matter; carriage of alluvium by the Arve, Rhone, and Durance; influence of regime of water course in transport of suspended matter; method of preventing silting up of storage reservoirs; rolling movement of materials along a stream bed; methods for determining time required for silting up reservoirs such as that of Max Singer and M. Wilhelm; and studies of length of time required for filling the proposed artificial Genissiat Lake on the upper Rhone. The Max Singer formula is used.

FRY, ALBERT S. See also Lane, E. W., 22.

1. Emory River flood of February 1939; Precipitation in Tennessee River basin, February 1939, pp. 7-12, illus. Knoxville, Tenn. Val. Authority, 1939. Report on Emory River flood of Feb. 3, 1939. Includes data on rainfall, flood run-off, flood damages, hydrographs, and flood profiles. The amount of silt carried by Emory River at Oakdale, Tenn., is estimated to be 122,000 tons corresponding to a soil loss of 0.08 acre-foot per square mile of drainage area. This amount is approximately 75 percent of the silt load for the entire year 1935.
2. Reservoir sedimentation surveys - objective and methods. Fed. Inter-Agency Sedimentation Conf., Denver, 1947, Proc. pp. 115-127, illus., 1948.

Describes the objectives of reservoir sedimentation surveys. Explains methods, and describes the equipment used in making reservoir surveys. Describes use of supersonic sounding equipment and the Walkie-Talkie radio. Mentions methods used for survey of deltas and study of bottom contours below or above a dam. Suggests possible future use of radar.

Discussion: HAROLD W. MURRAY, pp. 123-127, considers a few definitions and gives some illustrations showing fathogram records of the U. S. Coast and Geodetic Survey. JOHN A. MORRISON, pp. 127-128, points out features of supersonic sounding methods. Mentions types of recorders and role of Corps of Engineers in design of this equipment. CHARLES W. THOMAS, p. 128-130, reviews methods for accurate continuous means of position finding. Such electronic methods as radar, shoran, and a device known as "Raydist" are discussed. HAROLD W. MURRAY, p. 130, mentions use of two shoran installations for control of offshore hydrography by the U. S. Coast and Geodetic Survey. J. W. JOHNSON, p. 130, points out use of photography in reservoir surveys for establishing a horizontal control. C. L. HALL, p. 130, mentions use of "ducks" in beach surveys which are a branch of hydrographic surveying.

FRY, J. R., JR.

1. Willows for stream bank control. Soil Conserv., vol. 4, no. 5, pp. 109-111, 128, illus., Nov. 1938.

Describes a method employed in utilizing willows for stream bank control in the Coon Creek project, Wisc. Notes that Coon Creek has a silt content of 267 tons per day at the Coon Valley gaging station.

FRY, WILLIAM H. See Smith, J. C., 1.

FRYE, JOHN C.

1. Some small scale natural levees in a semi-arid region. Jour. Geomorph., vol. 4, no. 2, pp. 133-137, illus., Apr. 1941.

Describes the nature, characteristics and mode of deposition of the natural levees along Crooked Creek, Meade County, Kans. Gives physiographic description of the area.

FRYXELL, F. M.

1. (and Horberg, Leland). Alpine mudflows in Grand Teton National Park, Wyoming. Geol. Soc. Amer., Bul., vol. 54, pp. 457-472, illus., Mar. 1, 1943.

Describes Alpine mudflows which formed in August 1941 in the Teton Range, Wyo. Gives factors responsible for the formation of these mudflows. Notes that mudflows move rock debris into zones of stream attack. Discusses briefly mudflows in general.

FUERTES, JAMES H.

1. The purification of the water supply of Steelton, Pennsylvania. Amer. Soc. Civ. Engin., Trans., vol. 66, pp. 135-198, illus., 1910.

Describes in detail the plant for the purification of the water supply of Steelton, Pa. Includes a description of the quantity and quality of sediment in the Susquehanna River at Steelton and other physical characteristics of its waters. The plant treats water having an average turbidity of about 300 p. p. m.

Discussion: WILLIAM R. COPELAND, pp. 199-201, notes the economical use of a coagulant at the Steelton plant. Less coagulant is needed during rising flood since the material carried is coarse and settles rapidly. Describes the effect of iron salts as a coagulant in the Allegheny, Monongahela, and other waters of western Pennsylvania. JAMES E. LITTLE, pp. 201-206, considers the efficiency of the Steelton plant with particular reference to economical operation costs. Includes one paragraph noting the necessity for special treatment during sudden increases in turbidity. The turbidity increased from 25 to 1,500 p. p. m. in less than 7 hr., during Jan. 26-27, 1909.

D. G. THOMAS, pp. 208-209, notes conditions of turbidity in the Platte River near Denver, and briefly describes the use of an unusually long sedimentation reservoir at Lake Chessman and the slow sand-filter plant of the Denver Union Water Co. as effective clarifying agents.

- FUGGER, EBERHARD. See Woodford, A. O., 1.
- FULLER, EDWIN S. See Wilm, H. G., 1.
- FULLER, GEORGE W. See Hazen, A., 2; Hering, R., 1.
- FULLER, GLENN L.
- (and Eakin, Harry M.). The arrest and prevention of devastation by floods. U. S. Soil Conserv. Serv., SCS-MP-12, 11 pp., 1936.
Outlines procedure employed by the U. S. Soil Conservation Service for the preparation of an inventory of physical factors and conditions which are of fundamental importance in the determination of soil and water conservation practices on a watershed. Plan of attack to stop and prevent soil erosion, floods, and sediment output on a watershed is described.
- FULLER, MYRON L. See also American Society of Civil Engineers. Special Committee on Floods and Flood Prevention, 1.
- Rapidity of sand-plain growth [abstract]. Science, vol. 9, no. 227, pp. 643-644, May 5, 1899.
Describes the rapidity of sand-plain growth. Sand-plains represent deposits of sediments by glacial streams, deposited over a period of a single summer. The sand-plain near the railroad station at Barrington, R. I., has conditions suitable to determine the rate of sand-plain growth as well as the bulk of the sediment. From these the size and velocity of the stream transporting it can be easily determined.
- GABBARD, L. P. See Garin, A. N., 2.
- GALES, ROBERT RICHARD.
- The principles of river-training for railway bridges, and their application to the case of the Hardinge Bridge over the Lower Ganges at Sara. Inst. Civ. Engin., Jour., vol. 10, no. 2, pp. 136-200, illus., Nov. 1938.
Treats the principles of river-training for railway bridges and their application in the case of the Hardinge Bridge over the Lower Ganges, India. Discusses use of guide-bank system and gives description of the country in which the guide-bank system has been used. Comments on scour, training works, theory of apron, and cut-offs.
- GALLIHER, E. WAYNE.
- Cumulative curves and histograms. Amer. Jour. Sci., (ser. 5), vol. 26, no. 155, pp. 475-478, illus., Nov. 1933.
Discusses briefly the advantages of cumulative curves over histograms in the representation of the mechanical composition of sediments.
 - Factors in sedimentation analysis. Amer. Jour. Sci., (ser. 5), vol. 26, no. 156, pp. 564-568, illus., Dec. 1933.
Considers the technique and procedure of sedimentation analysis in determining the environmental origin of a compact sediment. Discusses the dispersion of samples before and during analysis and the sterilization of sedimentation sludge. Notes the need for more reliable methods of analysis.
- GALLOWAY, J. J.
- The rounding of sand grains by solution. Amer. Jour. Sci., (ser. 4), vol. 47, no. 280, pp. 270-280, illus., Apr. 1919.
Discusses the effect of solution on the rounding of sand grains. Notes that the lower effective size limit of rounding by abrasion is about 0.05 mm. Comments on factors concerned with rounding by solution such as rate of solution, size of grains, time, original shape of grains, cleavage, motion of grains and solvent, and purity of mineral. Concludes that any mineral make up can be rounded by solution; solution being especially competent on grains below 0.1 mm. in diameter. Comments on four types of sand grains produced by solution.
 - Value of the physical characters of sand grains in the interpretation of the origin of sandstones [abstract]. Geol. Soc. Amer., Bul., vol. 33, no. 1, p. 104, Mar. 1922.
Notes the physical characters of sand grains. Points out that limits of size and mechanical analysis was of little value in the interpretation of origin. States that by considering the mineralogical character, structures of grains, shape of grains, and surface of grains, the agents involved in the formation and transportation of friable sandstone or sand materials can be accurately determined.
- GALTISOFF, P. S.
- Limnological observations in the upper Mississippi, 1921. U. S. Bur. Fisheries, Bul., vol. 39, pp. 347-438, illus., 1923-24.
Results of investigation of the upper Mississippi River between Hastings, Minn., and Alexandria, Mo., to determine the changes in organic life in the stream resulting from the construction of Keokuk Dam. Presents brief data on dissolved and suspended load of the stream, sediment carried in various strata in the Mississippi and Missouri, turbidity of the Mississippi River and various tributaries, and turbidity conditions in various lakes on the stream.
- GAMBLE, D. L.
- (and Barnett, C. E.). Scattering in the near infrared; a measure of particle size and size distribution. Indus. and Engin. Chem., Analyt. Ed., vol. 9, no. 7, pp. 310-314, illus., July 15, 1937.
Reviews methods of measuring particle size and size distribution of powders. Describes a method based upon the transmission of suspensions at various wave lengths in the visible and near infrared regions. Estimates the relative average size and size-distribution characteristics of powders from the shape of the spectral transmission curve.
- GAPEN, KENNETH M.
- Grass and water storage on a quarter-million acre ranch. Soil Conserv., vol. 3, no. 6, pp. 161-162, 168, 170, illus., Dec. 1937.
Considers the formation of large arroyos, chiefly due to overgrazing, on a quarter million acre ranch near Solomonville, southeastern Ariz. in the Gila River watershed. Silt from these arroyos along the San Simon is carried through the washes to the Gila River and subsequently deposited in irrigation canals and ditches of farmers downstream and also becomes a big factor in gradual filling up of the San Carlos Reservoir behind Coolidge Dam. Notes that proper stocking, grazing control, and use of mechanical devices to control erosion are requisites in preventing damage to irrigated land and in preventing silting of reservoirs in the southwest range country.
- GARDNER, J. L. See also Hubbell, D. S., 1.
- (and Hubbell, D. S.). Study of the effects of silty irrigation water from an intermittent stream on crops and soils in controlled plots. Amer. Soc. Agron. Jour., vol. 34, no. 12, pp. 1090-1101, illus., Dec. 1942.
Deals with the effects of sediment-laden water from Mexican Springs Wash, an intermittent stream, on crops and soils in controlled plots. Reports the results of a 3-yr. treatment on crop plots at the Navajo Experiment Station.
- GARDNER, WILLARD. See also Jennings, D. S., 1.
- A new soil elutriator. Soil Sci., vol. 9, no. 3, pp. 191-197, illus., Mar. 1920.
Describes briefly a new type of soil elutriator. A diagrammatic sketch is used to show the nature of the process involved.
- GARIN, ALEXIS N. See also Roth, W. J., 1.
- (and Forster, G. W.). Effect of soil erosion on the costs of public water supply in the North Carolina Piedmont. U. S. Soil Conserv. Serv. SCS-EC-1, 106 pp., illus., July 1940.
Deals with the economic effects of soil erosion resulting from land use on the public water supply in the Piedmont area of North Carolina. Considers the financial burden which soil erosion places on the public in decreasing the storage capacity of municipal water supply reservoirs and in increasing the expenditures for the clarification of water for public use. Results of detailed studies of 22 reservoir sources of supply are given. Briefly describes the Piedmont Region. Considers, with respect to the cost of soil erosion, the deterioration of the land asset, cost of water purification, and the rates and value of annual sedimentation damage in the 22 reservoirs studied. The effect of land use on erosion and sedimentation is discussed. Proposed control measures and effects of existing erosion control practices are considered.
 - (and Gabbard, L. P.). Land use in relation to sedimentation in reservoirs, Trinity River basin, Texas. Tex. Agr. Expt. Sta. Bul. 597, 65 pp., illus., Jan. 1941.

Outlines the economic nature and scope of the reservoir silting problem and discusses the relative cost of soil conservation practices and consequent protection against depletion by silting of existing storage reservoirs in the Trinity River basin of Texas. Presents in detail, estimated costs of and evaluated benefits to be derived from a comprehensive upland erosion control program in the reservoir watershed of Kaufman City Lake. Estimates of damages due to sedimentation and of anticipated erosion control benefits to 18 reservoirs in the basin are given.

3. Soil erosion damages public water supply. *Soil Conserv.*, vol. 6, no. 7, pp. 178-180, illus., Jan. 1941.

Discusses, from an economic standpoint, the physical damage to municipal water supplies caused by silting. Presents results of a study conducted by the U. S. Soil Conservation Service and the North Carolina Agricultural Experiment Station covering water supply reservoirs in 22 reservoir drainage areas in North Carolina and in the Piedmont area to determine costs of depletion in storage capacities due to silting and to determine costs of clarifying or desilting the water for public use. Discusses the effect of erosion control measures on watersheds in lowering water plant operating costs, and in increasing the economic value of reservoirs by lengthening their life spans.

4. Advance report on the economic effects of predicted sedimentation in Morris Sheppard Lake, Texas. *U. S. Soil Conserv. Serv.*, SCS-ER-3, 18 pp., illus., Dec. 1941.

Outlines briefly the extent and cost of predicted sedimentation damage to Morris Sheppard Lake, Tex. Describes the need for a comprehensive investigation of the relationship of land use to erosion and sedimentation. Estimates the economic life of the Morris Sheppard Project to be 78 yr. and the average annual sedimentation damage to be \$67,000.

GARVIN, E. C.

1. Floodgates proposed for control of Savannah River. *Engin. News-Rec.*, vol. 83, no. 19, pp. 873-874, illus., Nov. 13-20, 1919.

Includes two paragraphs noting that 7,500,000 cu. yd. suspended and dissolved matter is carried annually into lower reaches of the Savannah River. Discusses rate of shoaling and its relation to mean channel depth or cross-sectional area of flow at Savannah Harbor. Amount of bed load estimated to be equal to 20 percent of total load.

GAUDIN, A. M. See Dobbins, W. E., 1.

GAULT, HOMER J.

1. (and McClure, W. F.). Report on Iron Canyon project, California, May 1920. 76 pp., illus. Washington, U. S. Reclam. Serv., 1921.

Reports the engineering and other considerations of the Iron Canyon project, Calif. Includes brief discussion on the problem of silt deposition within the reservoir.

GAVETT, WESTON. See Vanoni, V. A., 4.

GAVRILENKO, V. A.

1. Transportation of bed load [abstract]. *Sci. Res. Inst. Hydrotechnics, Trans.*, vol. 17, pp. 127-129, 1935.

Considers the determinations of the relationship between the values of Chezy's coefficient C and the roughness coefficient n , and the size and other characteristics of stream bed load.

GAYLORD, JAMES M.

1. Pumping on irrigation projects. *Reclam. Rec.*, vol. 9, no. 2, pp. 75-79, illus., Feb. 1918.

Describes operation of pumps and means of pumping water for irrigation purposes. Notes in one paragraph that where silt conditions are bad, pumps of moderate or large size should be provided with wearing rings which can be renewed to restore original efficiency and capacity.

GEIB, H. V.

1. A new type of installation for measuring soil and water losses from control plats. *Amer. Soc. Agron. Jour.*, vol. 25, no. 7, pp. 429-444, illus., July 1933.

Describes and gives directions for installation of a divisor box which was used on the soil erosion and moisture conservation control plats at the Blackland Experiment Station. Temple, Tex.

2. (and Goddard, Ira T.). Reconnaissance erosion survey of the Brazos River Watershed, Texas. *U. S. Dept. Agr., Misc. Pub.* 186, 47 pp., illus., Feb. 1934.

Deals with the erosion problem of the Brazos River Watershed, Tex. Considers sheet erosion, gullying, etc., and comments on recommended remedial measures.

GEOLOGICAL SURVEY. See U. S. Geological Survey. GERHARDT, U.

1. Application of Michelson's method of measuring stellar dimensions to the measurement of small particles [abstract]. *Franklin Inst. Jour.*, vol. 201, no. 5, pp. 667-668, 1926.

Deals with the use of Michelson's method for stellar measurements for the measurement of small particles. The diameter of a particle of .00024 mm. was measured.

GERKE, ROSCOE H. See Tolman, R. C., 2.

GERSBACHER, WILLARD M.

1. Development of stream bottom communities in Illinois. *Ecology*, vol. 18, no. 3, pp. 359-390, July 1937.

Gives results of studies of aquatic communities in artificial pools and streams of central Illinois. Three definite successional stages in the development of bottom communities were found on the bottom of artificial lakes. Discusses the effect of excessive silting on bed communities, particularly in Lake Decatur, Decatur, Ill., and Vermillion Lake, Danville, Ill.

GESSNER, HERMANN. See Krumbein, W. C., 2.

GHALEB, K. O. See Griffith, W. M., 1.

GHULATI, THAKAR DAS. See Bose, N. K., 1.

GIANDOTTI, MARIO.

1. Studi sullo portata solida del Po e sulle variazioni fisiche del suo alveo (Studies on the solid materials transported by the Po and on the physical changes of its bed). *Internatl. Geod. and Geophys. Union, Sect. for Sci. Hydrol. Bul.* no. 15, 21 pp., 1930. In Italian. Translation on file at the U. S. Soil Conservation Service, Washington, D. C., and the Research Center Library, Waterways Experiment Station, Vicksburg, Miss.

Discusses study of the sediment load of the Po River in the Pontelagoscuro section 1914-29 and in the Piacenza and Roncorrente sections 1924-29, to determine the effects of sediment on the physical behavior of the river. Studies include the relationship between the sediment load, the average annual river stage, the duration of high-water stage, and precipitation. Includes brief information on the aggradation of the Po. Derives formulas within the limits of suspended load for various gage heights. Notes that these formulas are applicable to the Po, but similar formulas might be derived for other rivers.

2. Contribution a l'etude du charriage des materiaux dans le lit des torrents (Contribution to the study of the bed loads of torrents). *Internatl. Cong. Navigation*, 15th, Venice, Serv. Hydrographique Italien, pp. 323-332, 1931. In French. Translation on file at the U. S. Soil Conservation Service, Washington, D. C.

Presents results of studies on quantities of bed load transported from streams of tributaries of the Po flowing in northern and central Apennine Mountains. Gives data on morphologic and hydrologic characteristics of the watersheds, stream-channel characteristics, and estimation of bed load per unit of drainage.

3. Les déplacements du lit du Po (Displacements of the bed of the River Po). *Internatl. Cong. Navigation*, 15th, Venice, Serv. Hydrographique Italien, pp. 297-322, 1931. In Italian. Translation on file at the U. S. Soil Conservation Service, Washington, D. C.

Report on studies of the bed and the sediment discharge of the Po River in connection with navigation. Gives results of studies of variations of ground sills, correlation between gage heights and water depths, observations on the

sediment load, amount of material carried in suspension by the Po at Pontelagoscuro, at Plaisance, and at Roncorrente, and by minor tributaries.

4. Regularisation and canalization works of rivers and streams. Internatl. Cong. Navigation, 15th, Venice, 1931, Rpt. 17, 11 pp., illus., 1931.

Discusses the problem of regulating the bed of the Po River, and gives the amount of suspended matter and bed material carried by this river since 1914. Notes use of various protective works.

5. *Idrologia generale* (General hydrology). 268 pp.

Florence, S. A. G. Barbera, 1937. (Biblioteca della Bonifica Integrale, vol. 3). In Italian.

Abridged translation on file at the U. S. Soil Conservation Service, Washington, D. C.

In 2 parts: Pt. 1, Hydrology, and Pt. 2, Fluvial Hydraulics. Under hydrology precipitation and ground moisture, runoff, temperature and evaporation of soil and water, and hydrologic regime of watersheds are discussed. Under fluvial hydraulics hydrologic and physical characteristics of streams are discussed. Under physical characteristics of stream, the report deals with loss of meandering, loss of correlation between the plain and profile of streams, suspended load in streams, experimental formulas on bed-load transport, the relationship of bed load to profiles, equilibrium profile of streams, silting of reservoirs, and formation of deltas in lakes.

GIBBS, A. S.

1. Report...on modules built on Shahkot Distributary, Main Ali Branch, Upper Gugera Division, Lower Chenab Canal, during 1910. Punjab Public Works Dept. Irrig. Branch, Papers, no. 13, pp. 3-48, Aug. 2, 1910.

Describes design and operation of modules built during 1910 on Shahkot Distributary, Main Ali Branch, Lower Chenab Canal, India. The effectiveness of the module system in saving silt clearances by increasing capacities of water courses to transport silt is described.

GIBLING, M. T.

1. Concise report on the Punjab Irrigation Works. Bombay, Public Works Dept., Tech. Paper 43, 19 pp., illus., 1932.

Describes briefly irrigation works in the Punjab. Discusses the factors involved in the design of canal headworks and describes methods of silt exclusion from canals. Notes retrogression problem of downstream levels of a weir. Considers the problem of silt regulation in the Punjab canals.

2. The fertility value of silt. India. Cent. Bd. Irrig., Pub. 19, pp. 138-143, 1938.

Contains extracts from literature available in the library of the Central Board of Irrigation, Simla, India, on the fertilizing value of silt. Includes extracts from reports of various agencies.

GIBSON, ARNOLD HARTLEY.

1. Model experiments on tidal estuaries. Engineering, vol. 137, no. 3563, pp. 520-521, May 4, 1934.

Discusses various problems in the use of models such as scale, grain size, textural roughness of bed material, and coagulation of silt of a colloidal nature. Comments on a tidal model used to investigate the probable effect of a proposed tidal power barrage across the Severn estuary.

2. The use of models in hydraulic engineering. Water and Water Engin., vol. 36, no. 442, pp. 697-704, illus., Winter 1934.

Discusses dynamic similarity in models and considers models used for investigating problems involved in the discharge over weirs of non-standard section and through sluice gates, and siphon spillways; and for investigating the effect of training works in river channels.

3. Tidal and river models. Inst. Civ. Engin., Jour., vol. 3, no. 8, sup., pp. 699-722, illus., Oct. 1936.

Considers the use of models in investigations of river action, and includes discussion on the use of bed materials in models and on the silt problem in model studies.

GIFFORD, JOHN.

1. Forestry in relation to physical geography and engineering. Franklin Inst., Jour., vol. 146, no. 1, pp. 1-19, illus., July 1898.

Discusses the effect of forestry in modifying the earth's surface, with particular reference to flood and flood-control works. Considers the utility of forests in the regulation of stream flow, and in the prevention of erosion and silting.

GILBERT, GROVE KARL. See also Hancock, R. T., 1; Kampmeir, R. A., 1.

1. Natural erosion by sand in the western territories [abstract]. Amer. Assoc. Adv. Sci., Proc., vol. 23, pp. 26-29, 1874.

Deals with the part played by sand in natural erosion in the western United States. Includes one paragraph on the efficiency of sand as an erosive agent when moved by water and states that functions of water in denudation are to dissolve rock, to transport sand which cuts rock, and to transport debris.

2. The Colorado Plateau as a field for geological study. Amer. Jour. Sci. and Arts, vol. 12, no. 67, pp. 16-24; no. 68, pp. 85-103, illus., 1876.

Describes the Colorado Plateau Province and factors which make it a field for geological study. Discusses transportation of detritus by flowing water. Notes that the velocity of a fully loaded stream depends on the comminution of the material of the load, and that a stream which can transport debris of a given size may be said to be competent to such debris. Points out that the rate of transportation and capacity for transportation are favored by fineness of debris, by declivity, and by quantity of water.

3. Report on the geology of the Henry Mountains. 160 pp., illus. Washington, 1877. (U. S. Geol. and Geol. Survey of the Rocky Mountain Region).

Presents report on the geology of the Henry Mountains in southern Utah. Includes discussion on the energetics of debris transportation by flowing water and on the shifting of waterways.

4. The topographic features of lake shores. U. S. Geol. Survey, Ann. Rpt., 5, pp. 75-123, illus., 1883-84.

Deals with the subject of lake shore topography. Includes 11 paragraphs discussing stream energetics in connection with delta formation in lakes and at the mouths of streams. Factors affecting stream capacity and competence for the transportation of detritus are debris load, size of particles, velocity, etc. Factors affecting delta formation are settling of suspended particles, channel shifting, bed-load movement, etc.

5. The sufficiency of terrestrial rotation for the deflection of streams. Natl. Acad. Sci., vol. 3, mem. 1, pp. 7-10, 1884.

Discusses analytically the sufficiency of the earth's rotation for the deflection of streams. Notes interdependence of conditions of erosion and deposition and form of stream cross-section, and the effect of curvature on the lateral shifting of a stream channel. Points out that the deflective force due to terrestrial rotation varies directly with the velocity of the stream, therefore it has a selective influence on the velocities within the cross-section, and tends to produce erosion at one side and deposition at the other (Ferrel). Gives formula for estimating deflective force when combined with centrifugal force in stream impact on banks with curves or meanders. Explains that "the efficiency of rotation thus advocated is only in connection with, and as an adjunct to, lateral wear by means of curvature."

6. Ripple-marks [letter to editor]. Science, vol. 3, no. 60, pp. 375-376, illus., Mar. 28, 1884.

Comments on Wooster's note (Science, vol. 3, no. 57, p. 274, Mar. 7, 1884.) on ripple-marked limestones in Kansas. The writer's own observations in Utah are described. Notes observations of ripple-marks on a surface of fine river silt at the bottom of a pool which had communication with a rushing river.

7. Lake Bonneville. U. S. Geol. Survey, Monog. 1, 438 pp., illus., 1890.

A technical paper which deals with the geology of Lake Bonneville. Includes description of conditions of delta formation in Lake Bonneville which depends chiefly on the law that the capacity and competence of a stream for the transportation of detritus vary directly with velocity.

8. Transportation of detritus by Yuba River [abstract]. *Geol. Soc. Amer., Bul.*, vol. 18, pp. 657-659, 1907.
Presented at the eighth annual meeting of the Cordilleran Section of the Geological Society of America, Dec. 28, 1906. Defines bottom and suspended loads of streams, describes the method of suspended-load determinations in the Yuba River and reports the conditions of aggradation in the valley section due to hydraulic mining accumulations. Presents data on the filling of the basin behind the dam, 5 miles below Smartsville narrows, during 1904 and 1905 with reference to the quantity of detritus arrested and the character of deposit. Note is made of stream discharge and the percentage of suspended load near the river mouth during the flood in 1905, and of data relative to the ratio of chief components of detritus at the mouth of the canyon during the 1906 flood.
9. The United States Geological Survey's Hydraulic Laboratory at Berkeley, California [abstract]. *Science n. s.*, vol. 27, no. 690, p. 469, Mar. 20, 1908.
Describes the hydraulic laboratory at Berkeley, Calif. which has been established for quantitative investigations of laws pertaining to the transportation of detritus by flowing water.
10. Hydraulic-mining debris in the Sierra Nevada. U. S. *Geol. Survey, Prof. Paper* 105, 154 pp., illus., 1913; [abstract], *West. Engin.*, vol. 9, pp. 5-7, Jan. 1918.
A comprehensive paper concerning the movement of hydraulic mining debris from Sierra Nevada and its deposition in the Sacramento and San Joaquin River basins and in the San Francisco Bay. Includes historical outline of hydraulic mining industry. Offers a description of the Great Valley of California, noting natural conditions of the Sacramento basin with particular respect to the movement of debris and regimen of rivers. Discusses subsidence of land in the San Francisco Bay region citing evidence relative to age and extent of subsidence and resultant effect on delta building. Points out that changes of conditions of these rivers are due to discharging of tailings from hydraulic mines either directly or indirectly into rivers, to land reclamation and levee building, and to transportation of debris. Discusses the accumulations of debris as piedmont deposits and as deposits in the valley rivers. Reports changes in conditions of bays due to the delivery of mud and sand by streams, and quantity and distribution of mining debris and debris from other sources such as agriculture, roads, trails and grazing. Describes deposits within the Sierra Nevada, in the piedmont belt, the valley, the rivers, the valley lands, the delta marshes, the bays, and the ocean. Studies were made on lower Yuba River of detrital load of stream, and of sedimentation in debris barrier No. 1. The scouring below debris barrier, seepage through dam, remodeling of river bed, Daguerre Point Dam and training walls noted. Calls attention to the future movement of debris in this region, the restraint of debris on the Yuba River, flood control in Sacramento Valley, the debris stored in mountain and piedmont deposits and its future distribution. Outlines processes and conditions of debris movement to Golden Gate bar, including a discussion of relationship between velocities and character of debris transported. Gives sources of bar material, changes in the bar, and interpretation of these changes. Deals with sedimentation on Pinole Shoal and in Mare Island Strait. Comments on the future outlook for hydraulic mining in Sierra Nevada. Compares the detailed surveys made by the United States Coast and Geodetic Survey of the bar at the entrance of the San Francisco Harbor.
11. The transportation of debris by running water. U. S. *Geol. Survey, Prof. Paper* 86, 259 pp., illus., 1914; [abstracts], *Engin. News*, vol. 72, no. 11, pp. 563-564, Sept. 10, 1914; *Engineering*, vol. 100, no. 2587, pp. 118-120, July 30, 1915.
Results of an investigation to determine the laws which control the movement of bed load in

a stream, and especially to ascertain the relationships between the quantity of bed load and stream slope, discharge, and degree of comminution of debris. Describes apparatus, material, and method of laboratory experiments conducted at Berkeley, Calif., in which the conditions of slope, discharge, and degree of comminution of debris were varied, and resultant variations of load were observed and measured. Considers slope, discharge, fineness, and form factors; velocity, which determines capacity for bed load; effect of mixtures of fine and coarse material on total load; modes of bed load transportation; application of derived formulas to natural streams; effect of stream load on energy of stream; conditions of load movement on the bottom of a flume; levels of maximum velocity in loaded and unloaded streams; and the constant of the Pitot velocity gage.

GILES, F. See Rennie, Sir John, 1.

GILLESPIE, C. G.

1. Water-supply problems and projects in California. *Engin. News-Rec.*, vol. 85, no. 10, pp. 446-448, illus., Sept. 2, 1920.

Considers water supply problems and projects in California. Notes silting up of canals and laterals due to 20 tons or more of dry silt per million gallons carried by the Colorado River. Silt of Colorado River settles out rapidly except when the Gila River is in flood. Use of sand filters and washers supplement sedimentation in clearing water for domestic supply. Describes projects to increase water supply for irrigation and domestic purposes; and calls attention to pollution of the Sacramento River with algae, sewage and silt.

GILLETTE, H. P.

1. The erosion of river bends [letter to editor]. *Engin. News*, vol. 44, no. 17, pp. 282-283, illus., Oct. 25, 1900.

Comments on an article (Haupt, L. M., 3) outlining suggestions for the improvement of the Southwest Pass of the Mississippi River. Refutes Haupt's theory of the use of a single convex jetty design outlined in Franklin Institute Journal as an alternative plan to the proposed two-jetty design of the U. S. Engineers. Examines theories on erosion and deposition of sediment in concave and convex river bends.

2. Coefficient of friction in dam design, and the failure of the dam at Austin, Texas. *Engin. News*, vol. 45, no. 22, pp. 392-393, illus., May 30, 1901.

Discusses various theories for the failure of the Austin Dam on Apr. 7, 1900. Includes one paragraph on the thrust resulting from accumulated silt back of the dam noting that it is impossible to attribute cause of failure to this since the thrust of liquid mud is less than water when the depth of the mud is over 25 ft. as it was back of the Austin Dam.

3. A novel and economic method of controlling streams. *Engin. and Contract.*, vol. 50, no. 15, pp. 339-340, illus., Oct. 9, 1918.

Describes the Pratt system of check dams to prevent erosion by torrential streams, to reclaim eroded areas of farm land, and to restore streams to their original channels. Includes illustration of a system of check dams in Laurel Canyon, near Los Angeles.

GILMAN, H. S. See Hoyt, W. G., 1.

GLADFELTER, H. S. See Howard, G. W., 1.

GLANGEAUD, M. L.

1. The movement of sediment and the formation of sand-banks, shelves and shoals in Garonne River and its estuary Bay of Gironde. *Internatl. Geod. and Geophys. Union, Comn. on Potamology, Rpt.* 6, question 3, 13 pp., 1939.

Points out that material is removed from suspension during ebb tide and put back into suspension during flood tide and coarser material is moved from the concave than from the convex meander. Notes that high velocity retains flocculated particles in suspension.

GLASS, E. L.

1. Floods of the Damodar River and rain-storms producing them [abstract]. *Engineering*, vol. 117, pp. 86-87, Jan. 18, 1924.

Paper presented before the Institute of Civil Engineers, Jan. 22, 1924. Notes that Damodar

River at Eldipur, India, has a wide sandy bed and shifting channel; floods overtop right bank for a length of 10 miles upstream. Silting of spill areas and flattening of bed-slope tighten the channel and raise levels of floods at a uniform rate of 1 ft. 2 in. for 10-yr. periods.

GLENN, LEONIDAS CHALMERS. See also Moore, W. L., 1.

1. The influence of forests on streams. Engin. Assoc. of the South, Trans., vol. 21, no. 5, pp. 67-94, 1910.

Considers the effect of forests on stream discharge and on erosion and silting in the Southern Appalachian region. Considers condition of silting in stream channels and in valleys; a consequence of accelerated erosion due to denudation of steep mountain slopes.

2. Tennessee River improvement and sedimentation. Amer. Forestry, vol. 16, no. 7, pp. 419-422, July 10, 1910.

A reply to testimony of Capt. E. N. Johnston, U. S. Army, before the House Committee on Agriculture, Mar. 2, 1910. Discusses the harmful effect that the eroded material from the steep headwater mountain slopes of the Tennessee River basin had on the navigable portion of streams, causing the formation of bars. Capt. Johnston refutes the importance of sand and gravel bars, stating that the majority of obstructions are hard rock ledges and that there is little or no bar-making material traveling downward in the river bed. The author takes exception to Capt. Johnston's testimony and proves, by quoting reports of army engineers, that most bars are of sand and gravel being brought from steep headwater mountain slopes and that there is a continual movement of such material down the bed of the river.

3. Denudation and erosion in the southern Appalachian Region and the Monongahela Basin. U. S. Geol. Survey, Prof. Paper 72, 137 pp., illus., 1911; [abstract], Wash. Acad. Sci. Jour., vol. 1, no. 8, pp. 236-237, Nov. 19, 1911.

Presents results of an examination of the southern Appalachian Region (1904 and 1905) and of the Monongahela Basin in West Virginia and Pennsylvania (1907) made for the purpose of studying the effects of deforestation and consequent erosion of deep mountain slopes on geologic, hydrologic, and economic conditions in the mountain region and in surrounding areas. Discusses the relation of industries to erosion and denudation with particular reference to the economic aspects of silting in reservoirs utilized for power purposes. Considers the nature, effects and remedies of stream and surface erosion. Notes conditions of erosion and sedimentation at Ducktown, Tenn., where fumes from smelters have denuded large hill-side areas. Treats changes in stream regimen where stream basins have been extensively cleared. The relations of the problems associated with denudation and erosion to agriculture and forestry are discussed. The conditions of denudation, stream and surface erosion, and stream and valley sedimentation in the basins of the Tennessee, Alabama, Apalachicola, Savannah, Santee, Pee Dee, and Monongahela Rivers are described.

GLOSSOP, RUDOLPH.

1. (and Skempton, Alec Westley). Particle-size in silts and sands. Inst. Civ. Engin., Jour., vol. 25, no. 2, pp. 81-105, illus., Dec. 1945.

Discusses the problem of particle size of silts and sands and gives various systems of particle-size classification. Notes distinctions between fractions of grades of various types of sediments. Concludes that the M. I. T. system of particle-size classification appears best suited to civil engineering purposes. The authors suggest modifications of the M. I. T. system.

GLYMPH, LOUIS M., JR. See also Love, S. K., 3.

1. (and Jones, Victor H.). Advance report on the sedimentation survey of Lake Booneville, Booneville, Arkansas. U. S. Soil Conserv. Serv., SCS-SS-3, 7 pp., illus., May 1, 1936.

A detailed survey of Lake Booneville, a municipal water supply reservoir located on a

minor tributary of Petit Jean Creek, 2 miles north of Booneville, Ark., to determine the extent of sedimentation in the reservoir since it was completed in February 1929. The original capacity was reduced by sedimentation from 289.45 acre-feet to 281.57 acre-feet during the 6.74 yr. which elapsed to the time the survey was made. This amount is equal to a total storage loss of 2.72 percent of the original capacity or 0.40 percent annually. It is estimated that not over 11 percent of the total drainage area of 2.6 sq. miles is under cultivation and that 75 percent is occupied by more or less heavily wooded slopes. Detailed information is included on the engineering features of the dam and reservoir and on the character, distribution, and volume of sediment.

2. (and Jones, Victor H.). Advance report on the sedimentation survey of Lake Sapulpa, Sapulpa, Oklahoma. U. S. Soil Conserv. Serv., SCS-SS-7, 9 pp., illus., Aug. 1936.

A sedimentation survey during the period Dec. 5, 1935 to Jan. 10, 1936, indicated that Sapulpa Reservoir, a municipal water supply reservoir located on Euchee Creek, 5 miles west of Sapulpa, Okla., had lost due to silting since its completion in 1913, 16.72 percent of its original capacity. The original capacity was 1,094 acre-feet and in 22.5 yr. of operation 183 acre-feet of sediment had accumulated in the reservoir an average annual loss of 0.74 acre-feet. Of the 8.72 sq. miles of watershed area, it is estimated that 20 percent is forested, 10 percent cultivated, and 70 percent is scanty pasture with scattered shrub oak. Sediment carried into Lake Sapulpa originates chiefly from easily eroded terrace silts in the main valley and from soil derived by vigorous runoff from the slopes of the watershed. Includes detailed data relative to volume, distribution, and character of sediment in reservoir, also information pertaining to the engineering features of the dam and the reservoir.

3. (and Jones, Victor H.). Advance report on the sedimentation survey of Lake Bennett, Conway, Arkansas. U. S. Soil Conserv. Serv., SCS-SS-9, 5 pp., illus., Oct. 1936.

A sedimentation survey, Nov. 2 to 22, 1935, of Lake Bennett, located on two small branches of East Fork Creek, 22 miles north of Conway, Ark., and which serves as a recreational lake as well as a basis for the study of reservoir silting in a drainage area subject to erosion control measures. Survey revealed that the 492-acre-foot reservoir had lost 0.81 percent of its capacity due to silting since its completion on June 24, 1935. The total accumulation amounted to 4 acre-feet, average accumulation per year is estimated at 10.8 acre-feet or 2.20 percent of original capacity. Of the 4.16 sq. miles of watershed area, 61 percent is forest, 27 percent cultivated, and 12 percent is pasture or idle land. Detailed data are given on the character of the watershed, soils, topography, land use, erosion conditions, and erosion-control practices. Information is included relative to the character, distribution, origin of the sediment in the reservoir, and to the engineering features of the dam and reservoir. States that most of the coarse material derived from erosion in the watershed has been deposited above the reservoir during the 4 1/2 mo. of its life, and that erosion control practices in the reservoir watershed should become progressively more effective in reducing sediment output from watershed. A period of 4.5 mo. is considered too short to give a reliable indication of anticipated silting rate.

4. (and Jones, Victor H.). Advance report on the sedimentation survey of Lake Decatur, Decatur, Illinois. U. S. Soil Conserv. Serv., SCS-SS-12, 23 pp., illus., Apr. 1937.

A sedimentation survey, April to July 1936 revealed that Lake Decatur, a municipal water supply reservoir located on the Sangamon River, at Decatur, Ill., had lost 14.23 percent of its original capacity by silting since completion of the reservoir in April 1922. The original capacity of the reservoir was 19,738 acre-

feet and in the 14.2 yr. that it was in operation, 2,808 acre-feet of sediment accumulated in the reservoir. The average annual loss amounted to 1 percent of the original capacity. Of the watershed area of 906 sq. miles, 82 percent is crop land, 15 percent pasture, and only 3 percent forest. The sediment in the reservoir is derived chiefly from the surficial loess and loess-derived soils in the watershed and to some extent from wave erosion of the lake shore. The report contains detailed information relative to the origin, character, distribution and volume of sediment in the reservoir, also information pertaining to the engineering features of the dam and reservoir. Recommendations for protection of the reservoir against silting are included.

5. (and Jones, Victor H.). Advance report on the sedimentation survey of Lake Calhoun, Galva, Illinois. U. S. Soil Conserv. Serv., SCS-SS-16, 9 pp., illus., May 1937.

A sedimentation survey, July 23 to Aug. 6, 1936, at Lake Calhoun, a recreational reservoir, located on Fitch Creek, 5 miles southeast of Galva, Ill. revealed that the original 286-acre-foot reservoir had lost 52.10 percent of its capacity, due to silting since its completion on Sept. 1, 1924, an average annual depletion of 4.37 percent. Total deposits in reservoir during the 11.9 yr. of operation amounted to 149 acre-feet, an average annual accumulation of 12.5 acre feet. Of the 13.1 sq. miles of watershed area 65 percent is cultivated land, 20 percent is permanent open pasture, 14 percent is woodland pasture, and 1 percent is idle land. The reservoir silt is chiefly derived from erosion of the loess and loessial soils of the watershed, caused by forest removal, intensive grazing, and erosion-inducing farm practices. The need for erosion-control measures in the watershed in order to extend the life and usefulness of the reservoir is stressed. Report includes detailed data pertaining to the engineering features of the dam and reservoir, character of watershed, and character, distribution, and origin of reservoir sediment.

6. (and Jones, Victor H.). Advance report on the sedimentation surveys of Lakes Crook and Gibbons, Paris, Texas. U. S. Soil Conserv. Serv., SCS-SS-17, 15 pp., illus., Oct. 1937.

Gives results of sedimentation surveys made during the periods Feb. 27 to Mar. 27, and Mar. 25 to 31, 1936, respectively. Lake Crook, on Pine Creek, is present source and Lake Gibbons, on a small tributary of the north branch of Pine Creek, was former source of water supply of the City of Paris. Lake Crook Reservoir lost due to silting since its completion in February 1923, 6.37 percent of its original capacity. The original storage capacity of 11,487 acre-feet was reduced to 10,755 acre-feet after 13.1 yr. of operation, an average annual accumulation of 55.9 acre-feet or 0.49 percent of its original capacity. Lake Gibbons lost 5.52 percent of its original capacity since its completion in 1900. The storage capacity was reduced from 1,414 to 1,336 acre-feet in 36 yr., an average annual accumulation of 2.17 acre-feet or 0.15 percent of original capacity. Includes information on the engineering features of the dams and the reservoirs and the general character of the watersheds. Detailed data are given on the geology, topography, soils, erosion conditions, and land use. Describes character, distribution, and origin of sediment in the reservoirs. Results of surveys indicate that a considerable amount of silt entering reservoirs is carried through the reservoirs and over the spillways, and that the chief characteristic of the reservoir sediment is uniformity in distribution, texture, and composition. Almost all the lake sediment is derived from sheet and minor gully erosion on 75 percent of the watershed.

7. Advance report on the sedimentation survey of Hurley Lake, Gettysburg, South Dakota. U. S. Soil Conserv. Serv., SCS-SS-26, 17 pp., illus., Sept. 1938.

A sedimentation survey, June 9 to 24, 1937, at Hurley Lake, a recreation and water conservation development, located on Little Cheyenne Creek, 11.5 miles northwest of Gettysburg, S. Dak., revealed that the 1,226-acre-foot reservoir had lost 3.02 percent of its original capacity due to silting since completion in December 1932, an average annual depletion of 0.67 percent. Total deposits in the reservoir after 4.5 yr. of operation amounted to 37 acre-feet, an average annual accumulation of 8.2 acre-feet. Of the total of 70 sq. miles of drainage area, 37 percent is cultivated, 11 percent is in wild hay, 25 percent is pasture and natural range, 24 percent is idle, and 3.0 percent in farmsteads. Detailed data are given pertaining to engineering features of dam and reservoir, character of watershed, and character and distribution of reservoir sediment. Report includes results of detailed surveys of two representative stock ponds in the Hurley Lake drainage basin to evaluate the gross effect of all stock ponds on sedimentation in the main lake. Bartel's pond located on a small tributary of Little Cheyenne Creek, about 7 miles northeast of Hurley Lake, had lost, due to sedimentation 34.88 percent of its original capacity after 29 yr. of operation. Johnson's pond located on a small tributary of Little Cheyenne Creek, about 7.2 miles north-northeast of Hurley Lake, had lost 27.73 percent of its capacity in 25 yr. of operation. Gives brief description of the drainage basins of respective stock ponds. Reports detailed data on the volume-weight relations of sediment from Hurley Lake and the two stock ponds. Concludes from estimated data on watershed erosion rates and rates of sedimentation in reservoir and ponds that (1) there probably exists a higher-than-average rate of sediment output in areas draining into stock ponds, (2) there may be less complete desilting of flood waters in Hurley Lake than in stock ponds, and (3) stream and valley sedimentation takes place upstream from Hurley Lake.

8. Silting of reservoirs. 5 pp. Washington, Internatl. Geod. and Geophys. Union, Round-table Discuss., Sept. 13, 1939.

Prepared for the round-table discussion on The Role of Hydraulic Laboratories in Geophysical Research, at the National Bureau of Standards, Sept. 13, 1939, relative to an investigation of reservoir silting. Discusses the program for study of reservoir silting, and indicates future needs in this field.

9. Advance report on the sedimentation survey of Lake Clinton, Oklahoma. U. S. Soil Conserv. Serv. SCS-SS-35, 19 pp., illus., July 1940.

A sedimentation survey on Lake Clinton, a municipal water supply and recreation reservoir located on Turkey Creek, 16 miles west of Clinton, Okla. The original storage capacity of the reservoir was 4,415 acre-feet when completed in 1930. About 69 percent of the 22.47 sq. miles in the watershed is cultivated. From December 1930 to June 1938, a period of 7.4 yr, 434 acre-feet of sediment accumulated in the reservoir, a volume equal to a total storage loss of 9.33 percent of the original capacity at a rate of 1.33 percent annually. About 97 percent of the drainage area has been affected to some extent by sheet erosion, 70 percent by wind erosion, and about 95 percent by gullying. The dry weight per cu. ft. of sediment in the reservoir ranges from 39.21 to 91.65 lbs. Includes information relative to the engineering features of the dam and reservoir, and to the character, distribution, and sources of sediment in the reservoir. Recommends measures for reducing the rate of sediment accumulation.

GODDARD, IRA T. See Geib, H. V., 2.
GOLDICH, SAMUEL S.

1. A study in rock weathering. Jour. Geol., vol. 46, no. 1, pp. 17-58, illus., Jan./Feb. 1938.

A study in rock weathering of samples from four districts. Proposes a mineral-stability series in weathering; the common rock-forming minerals are found to coincide with the reaction series. The attack of silicate minerals by water is in agreement with the mineral-stability series which has been suggested.

GOLDMAN, F. H. See Dalla Valle, J. M., 1.
GOLDMAN, MARCUS I.

1. Petrographic evidence on the origin of the Catahoula Sandstone of Texas. *Amer. Jour. Sci. (ser. 4)*, vol. 39, pp. 261-287, Mar. 1915.

A petrographic investigation which presents evidence pertaining to the origin of the Catahoula Sandstone. Considers the lower limit of rounding of sand grains in wind and water. Deals with the use of ratio of feldspar to quartz, mechanical analysis, ratio of fresh to weathered feldspars, ratio of heavy to light minerals, fossils, etc. in order to draw conclusions on the interpretation of the Catahoula Sandstone.

2. The petrography and genesis of the sediments of the Upper Cretaceous of Maryland. *Md. Geol. Survey, Upper Cretaceous*, text, pp. 111-182, 1916.

Presents the results of a detailed mechanical and microscopic analysis of a few typical sediments from the Upper Cretaceous of Maryland. Thoulet's method of analysis is followed in general. Describes the procedure used and presents results obtained. Comments on three types of sediments: the delta type, the estuarine, and the open-water glauconitic type. Offers interpretations as to the genesis of the sediments studied.

GOLDSTEIN, AUGUST, JR.

1. Statistical data on the size-distribution of sands and gravels from the Mississippi River and its tributaries. *Natl. Res. Council, Div. Geol. and Geog., Com. Sedimentation, Rpt. (1940-41)*, Exhibit C, pp. 15-25, tables, Mar. 1942.

Presents tables which consist of statistical data computed from analyses made by the U. S. Waterways Experiment Station and published in a paper entitled *Studies of River Bed Materials and Their Movement*, with Special Reference to the Lower Mississippi River (U. S. Waterways Experiment Station, 13).

GOLDSTEIN, SIDNEY

1. The forces on a solid body moving through viscous fluid. *Roy. Soc. London, Proc. Ser. A, Math. and Phys. Sci.*, vol. 123, pp. 216-225, Apr. 1929.

Consists of a mathematical treatment of forces on a solid body moving through viscous fluid.

2. The steady flow of viscous fluid past a fixed spherical obstacle at small Reynolds number. *Roy. Soc. London, Proc. Ser. A, Math. and Phys. Sci.*, vol. 123, pp. 225-235, Apr. 1929.

A mathematical treatment of the steady flow of viscous fluid past a fixed spherical obstacle at small Reynolds numbers.

3. On the stability of superposed streams of fluids of different densities. *Roy. Soc. London, Proc. Ser. A, Math. and Phys. Sci.*, vol. 132, no. A820, pp. 524-548, Aug. 1931.

The stability of superposed fluids with a finite width of layer of transition is investigated by the method of small oscillations. The investigation is a mathematical treatment of the problem. The study is a generalization to heterogeneous stratified fluids of Rayleigh's study of the homogeneous case.

GOLLOWAY, J. D. See Harts, W. W., 2.

GOLZE, A. R.

1. Operation and maintenance of canals. *Fed. Inter-Agency Sedimentation Conf., Denver, 1947, Proc.*, pp. 200-204, 1948.

Deals with the maintenance or cleaning of silted irrigation canals, laterals and drains. Problem of silting in canals and measures to prevent it are discussed. Methods and costs of removing silt from irrigation canals are commented upon. The use of Ruth Dredgers, draglines, scrapers, etc. is commented upon. Discussion: R. H. RUPKEY, pp. 204-206, comments on problem of desilting encountered by the Indian Service in the operation and maintenance of canals. NARENDRA K. BERRY, pp. 206-208, mentions briefly the silt problem in canals in India, especially in the Punjab Province. Mr. Kennedy's, a Punjab irrigation engineer, and Mr. Lindley's formulas are given. Lacey's formulas are also put forth.

GONCHAROV, V. N.

1. The movement of sediment on the channel bottom. *Sci. Inst. Amelior., North Caucasus Br.*, 1929, pp. 851-920. In Russian. Translation on file at the U. S. Soil Conservation Service, Washington, D. C., and the University of California, Berkeley, Calif.

Discusses the problem of the movement of sediment on the channel bottom. Notes the various scientific agencies in Russia concerned with this problem in sedimentation. Comments on apparatus for the measurement of bed load. Gives Wilfred Airy's formula and fundamental equations for the friction forces in the stream. Gives equations for movement of sediment along the channel bottom. Various results are given.

2. Flow around cubes fixed to the bottom of a flume [abstracts]. *Amer. Soc. Civ. Engin., Proc.*, vol. 63, no. 9, pp. 32-35, Nov. 1937; *Iowa Univ., Studies in Engin.*, Bul. 19, p. 60, May 1939.

Investigates the physical phenomena connected with the flow around a cube fastened to the bottom of a flume and the quantitative forces exerted by flowing water on such a cube, the final aim being the determination of the relation between the amount of bed load moved, the size and unit weight of bed-load particles, and the mean velocity of flow.

GOODEN, ERNEST L.

1. (and Smith, Charles M.). Measuring average particle diameter of powders—An air-permeation apparatus. *Indus. and Engin. Chem., Analyt. Ed.*, vol. 12, no. 8, pp. 479-482, illus., Aug. 15, 1940.

Describes a self-calculating, air-permeation apparatus for direct determination of surface-weighted average particle diameters of powders. It indicates the surface-weighted average diameter directly; no calculations are required provided the density is known in advance.

GOODHUE, LYLE D.

1. (and Smith, Charles M.). Particle size of insecticidal dusts; a new differential manometer-type sedimentation apparatus. *Indus. and Engin. Chem. Analyt. Ed.*, vol. 8, no. 6, pp. 469-472, illus., Nov. 15, 1936.

Describes a new type of sedimentation apparatus which uses the principle of the differential manometer.

GOODRICH, R. D.

1. Causes and control of major floods. *Amer. Geophys. Union, Trans.*, vol. 19, pp. 647-653, 1938.

Deals with factors causing major floods and describes measures for their control. Discusses briefly alterations in the regimen of streams due to geologic changes. The condition of stream overflow, resulting in fertile flood plain deposits, and the building up of banks are described. Cites the effect of dikes and levees in preventing overflows. Describes flood control measures undertaken on the Sacramento, Mississippi, Po, Ganges, Nile, and Huang Ho Rivers. Considers the dual system of dikes on the Huang Ho, the flood relief channels on the Sacramento and Mississippi Rivers, and the levees on the River Po.

GOPAL, N.

1. Silt problem in Punjab canals. *Indian Engin.*, vol. 104, pp. 167-168, Nov. 1938.

A report discussing the ineffectiveness of Punjab canals designed to transport silt without scour or deposition and noting that the problem of effective canal design may be solved by silt exclusion.

GOPALAKRISHNAN, C.

1. [Review of] Regime flow in incoherent alluvium, by Gerald Lacey. *Cur. Sci.*, vol. 10, no. 3, pp. 139-142, Mar. 1941.

Summarizes Lacey's quantitative development of regime equations for flow in incoherent alluvium. Points out that Lacey concludes that a constant discharge, with a silt load of a given grade and flowing in an alluvial plain of the same grade eventually tends to maintain a gradient determined by the silt grade and discharge. Notes that the mean velocity, depth, hydraulic mean, and wetted perimeter tend to unique determination.

GORRIE, R. MACLAGAN

1. The use and misuse of land. Oxford Forestry Mem. 19, 80 pp., illus., 1935.
Deals with various aspects of land misuse in the United States and stresses the need for a well-planned land policy as a control measure. The effects of the misuse of reservoir catchment areas on conditions of silting in reservoirs are briefly considered. Notes that rate of silting of the Gibraltar Reservoir rose from 160 to 600 acre-feet per annum (1920-34), Arrowrock Dam silted up 8,000 acre-feet during its first 15 yr. of service, and Elephant Butte Dam lost 10.4 percent of its capacity in 18 yr.
2. Torrent action interferes with canal efficiency. Cur. Sci., vol. 5, no. 2, pp. 62-67, illus., Aug. 1936.
Discusses the effect of torrent action on irrigation canals in India. Describes works constructed to control torrential flow. Briefly notes use of silt extractors to collect and remove silt carried by flood torrents in the upper Jhelum Canal.

GOSS, ARTHUR

1. Principles of water analysis as applied to New Mexico waters. N. Mex. Agr. Expt. Sta., Bul. 34, pp. 55-106, June 1900.
Discusses the method of reporting water analyses, describing the substances determined in the analysis of waters, and presenting results of analyses of waters of New Mexico. Data are also given on dissolved and suspended matter in the Rio Grande near the Agricultural College (1893-94), at Earham Bridge (1899), at various sites in the Pecos River (1899), in the Animas River (Aug. 1896), in the Rio Bonito (Jan. 12, 1894), in the Santa Fe River (May 23, 1899 and Jan. 15, 1900), and in Running Stream (Apr. 11, 1899). The given data are discussed with particular consideration given to the character of the sediment of the Rio Grande; plant food elements in the sediment, value of the sediment as a fertilizer, and the effect of sediment in waters irrigating alfalfa.

GOTTSCALK, LOUIS C. See also Hansen, O. C., 1; Stall, J. B., 1.

1. Compilation of literature on sedimentation. U. S. Soil Conserv. Serv., Sedimentation Div., Tech. Let. Sed-10, 2 pp., 37 pp., illus., Apr. 1, 1939.
Discusses a Works Progress Administration Project, under the sponsorship of the Sedimentation Section in New York City for the review of sedimentation literature. Gives the purpose of the project, which is to organize into a bibliography the technical literature pertaining to transportation and deposition of sediment and to compile an inventory of dams and reservoirs in the United States. Contains an attached Manual of Instruction which was prepared as a guide for W. P. A. employees assigned to the project.
2. Sedimentation investigation of Carnegie Lake, Princeton, N. J. U. S. Soil Conserv. Serv., Spec. Rpt. no. 1, 5 pp., Sept. 1942.
An investigation made July 18, 1939, of sedimentation conditions in Carnegie Lake, a shallow channel-type lake, located on Millstone River, 2 miles northeast of Princeton, N. J., to determine, in the dredged area of Stony Brook arm, the extent of silting since 1938, and to determine the source of the erosional debris.
3. Notes on reservoir silting and suspended-load measurements in Washington. U. S. Soil Conserv. Serv., Spec. Rpt. 2, 15 pp., illus., Oct. 1942; [abstract], Amer. Waterworks Assoc. Jour., vol. 36, no. 1, pp. 110-111, Jan. 1944.
The quantitative data on reservoir sedimentation in this report were obtained by the late William T. Holland of the Sedimentation Section, Soil Conservation Service, while making a reconnaissance inspection of reservoirs in the State during May, June, and July 1936. The data on the silting basin at Wilsoncreek were obtained by a detailed engineering survey made by the Sedimentation Section of the Soil Conservation Service. No detailed reservoir surveys to determine loss of storage capacity by silting have been made in Washington. The estimates

of capacity losses given in this report are based on results obtained by reconnaissance sedimentation surveys. The data contained in this report are confined to less than 25 percent of the reservoirs in the State. The reservoir and silting data are discussed according to the principal drainage basins in Washington.

4. Results of an experiment on the improvement of sandy soil with river silt. U. S. Soil Conserv. Serv., Spec. Rpt. 3, 11 pp., illus., Nov. 1942.
Describes a preliminary experiment conducted during the spring of 1937 to determine the yield of millet on Sassafras loamy sand obtained from a sub-marginal farm near Upper Marlboro, Md. This soil under greenhouse conditions was treated with an admixture of various quantities of silt obtained from the adjacent Patuxent River. It is believed that the increase in the yield of millet caused by mixing silt with the soil is due mainly to the fertilizing and soil conditioning effect of the silt. As a wartime conservation measure, the use of silt might be considered as a possible supplement to commercial fertilizers in this region.
5. Notes on reservoir silting and suspended-load measurements in Idaho. U. S. Soil Conserv. Serv., Spec. Rpt. 4, 16 pp., illus., Jan. 1943; [abstract], Amer. Waterworks Assoc. Jour., vol. 36, no. 1, p. 111, Jan. 1944.

The data included in this report were obtained from published and unpublished sources, and from field investigations by personnel of the Sedimentation Section of the Soil Conservation Service. Quantitative data on sedimentation in Idaho are very limited, but in certain small areas, particularly the Boise River basin, enough data are available to warrant definite conclusions as to the extent of silting problems. The only detailed study to determine rate of reservoir silting was made on Black Canyon Reservoir on the Payette River in 1936. Suspended-load measurements of value are those made on streams with small drainage areas located in the Boise River basin and South Fork of the Palouse River. Reservoir and silting data are given for the principal drainage basins in Idaho. Presents a table of all available suspended-load data for the State.

6. Report on the sedimentation surveys of Loch Raven and Prettyboy Reservoirs, Baltimore, Maryland. U. S. Soil Conserv. Serv., Spec. Rpt. 5, 21 pp., illus., Dec. 1943.

Reconnaissance sedimentation surveys of Loch Raven and Prettyboy Reservoirs were made October 4-9, 1943, to determine the extent of soil erosion in the Gunpowder Falls watershed and its effect on these downstream storage developments which are part of the water supply system of Baltimore, Md. The average annual rate of sediment production per acre of drainage above Loch Raven Reservoir was found to be 42.0 cu. ft., while the corresponding rate above Prettyboy Reservoir was 47.6 cu. ft. The annual rate of storage depletion was found to be 0.3 percent for Loch Raven Reservoir and 0.1 percent for Prettyboy Reservoir. The main source of sediment deposited in Loch Raven and Prettyboy Reservoirs is sheet erosion of cultivated land. Use of approved soil conservation measures is capable of reducing the volume of sediment delivered to stream.

7. Sedimentation in a great harbor. Soil Conservation, vol. 10, no. 1, pp. 3-5, 11-12, illus., July 1944; reprinted in Md. Farmer, vol. 28, no. 8, pp. 2, 14-15, illus., Aug. 1944, and Baltimore, vol. 37, no. 12, pp. 41-44, illus., Sept. 1944; [extract], The Baltimore Evening Sun, p. 17, Sept. 5, 1944.

Discusses sedimentation in Baltimore harbor, giving past history pertaining to the subject. Notes that during the past 100 yr. the Federal Government has removed 111,000,000 cu. yd. of material from Baltimore harbor at a cost of nearly \$17,000,000. Points out that soil erosion in the watersheds tributary to the Patapsco Bay accounts for the major part of these dredging costs. Notes the effect of sedimentation on water-supply reservoirs of the city. States that a well-planned program of erosion-control measures could reduce the sediment inflow nearly 75 percent in this region.

8. Report on the reconnaissance sedimentation survey of Radford Reservoir, Radford, Virginia. U. S. Soil Conserv. Serv., Spec. Rpt. 7, 14 pp., illus., Nov. 1944.

This report contains the results of a reconnaissance sedimentation survey of Radford Reservoir located on the Little River, 4 miles south of Radford, Va. In 10 yr, sedimentation has reduced the original storage capacity 38.2 percent. At the present rate of silting, and assuming that the normal channel of the stream is equal to 15 percent of the original capacity of the reservoir, it will require only 12 to 13 yr. for the capacity of this reservoir, now above normal channel conditions to become entirely lost. The operation of the power plant will depend entirely upon current stream flow. The low ratio of capacity to inflow is the principal factor accounting for the rapid rate of sedimentation in Radford Reservoir.
 9. Effects of soil erosion on navigation in upper Chesapeake Bay. Geog. Rev., vol. 35, no. 2, pp. 219-238, illus., Apr. 1945.

Comments on sediment deposition in the ports of the Chesapeake Bay area and states that at the head of Chesapeake Bay, 85,000,000 cu. yd. of sediment were deposited between 1846 and 1938. This is due mainly to uncontrolled erosion which started with the wholesale clearing and cultivation of land. Treats of sedimentation in the Gunpowder Arm, Potomac River Arm, at Bladensburg and Piscataway, Md., the Potomac River near Mt. Vernon, Neabsco Creek and Dumfries, Va., Port Tobacco, Md., the Patuxent River Arm, the Patapsco River Arm, and Baltimore. Notes cost of dredging in the area. States that a soil conservation program of erosion-control measures would reduce the sediment inflow into the Baltimore harbor nearly 75 percent. Shows the need for a well-planned, long-range program to reduce harbor and maintenance costs.
 10. Silting of stock ponds in land utilization project areas, SD-LU-2, Pierre, South Dakota. U. S. Soil Conserv. Serv., Spec. Rpt. 9, 11 pp., illus., May 1946.

Presents the results of an investigation of the effects of silting on stock ponds and reservoirs in the Land Utilization Project (SD-LU-2) of the Soil Conservation Service, located near Pierre, S. Dak. The object of the study was to furnish a basis for estimating maintenance costs on 43 Government-owned reservoirs and stock ponds. The field investigation made in June 1945 dealt with reconnaissance sedimentation surveys of 18 representative ponds and reservoirs.
 11. A method of estimating sediment accumulation in stock ponds. Amer. Geophys. Union, Trans., vol. 28, no. 4, pp. 621-625, illus., Aug. 1947.

This paper describes detailed sedimentation studies of 18 Government-owned stock-water ponds in central South Dakota for the purpose of estimating sediment accumulation in 43 such ponds. A multiple-regression analysis was made to determine the function of various factors related directly or indirectly to sediment accumulation. The method provided a formula for estimating sediment accumulation in all ponds in the area.
 12. Analysis and use of reservoir sedimentation data. Fed. Inter-Agency Sedimentation Conf., Denver, 1947, Proc., pp. 131-138, illus., 1948.

Points out relative effects of factors that need to be considered in the analysis and interpretation of reservoir sedimentation data. Outlines briefly methods for applying the results. Shows need for additional data and research. Discussion: M. G. BARCLAY, pp. 138-139, comments on importance of intensive study of sediment deposition, and need of accurate surveys. M. A. CHURCHILL, pp. 139-140, notes briefly the method of analyzing reservoir sedimentation data used by the TVA. Use of a ratio termed the Sedimentation Index is discussed. GAIL A. HATHAWAY, p. 140, raises the question as to when a reservoir ceases to become a reservoir and is a stock pond. THE AUTHOR, p. 140, points out that 5 percent of the 600 reservoirs on which the Soil Conservation Service has data are stock ponds and that a stock pond is a special type of reservoir. VICTOR H. JONES, pp. 140-141, comments on the relationship between stock ponds and reservoirs.
 13. Sounding and spudding lines. U. S. Soil Conserv. Serv., Sedimentation Div., Tech. Let. Sed-19, 4 pp., illus., Aug. 1, 1948.

A technical letter which sets forth available information on types, marking, availability, painting, and care of sounding and spudding lines.
 14. Methods used by the Soil Conservation Service in measuring sediment deposits [abstract]. Civ. Engin., vol. 19, no. 5, pp. 328-329, May 1949.

A report presented at the ASCE Hydraulics Division meeting in Oklahoma City which deals with methods used by the U. S. Soil Conservation Service in measuring sediment deposits, effect of conservation practices, purpose of reservoir sedimentation surveys, objectives of surveys, and factors affecting the rate of sediment production. Notes that experimental data from plats and small watersheds show that reductions in soil losses of 65-95 percent can be effected from soybean, corn, and cotton land by proper tillage practice and crop rotation.
- GOTWALS, JOHN C.
1. Reinforced concrete permeable dikes. Engin. and Contract., vol. 65, no. 5, pp. 261-263, illus., Nov. 1926.

Describes results of experimental work on the use of reinforced concrete permeable dikes as a substitute for permeable wooden dikes on the Mississippi River between the mouths of the Ohio and Missouri Rivers. Discusses disadvantages of wooden dikes and describes and compares three types of reinforced concrete dikes.
- GOULD, HOWARD. See Emery, K. O., 3.
- GRABAU, AMADEUS WILLIAM
1. Principles of stratigraphy. Ed. 2, 1185 pp., illus., New York, A. G. Seiler, 1924.

A comprehensive treatise on stratigraphy. Considers the transporting and erosive powers of currents. Gives the following: A table showing the amount of solid material carried by various rivers of the world (p. 248), a table of velocities required to stir up bottom materials (p. 248), and a table showing size of rock fragments moved by different velocities of current (pp. 251-252). Treats of the sorting power of rivers and the rounding of sand grains (pp. 252-257).
- GRAHAM, HOYT CONLIN
1. The effect of electrolytes and hydrogen ion concentration on the sedimentation of Pleistocene clays. 21 pp., tables. Aug. 1927. Thesis in chemistry—State University of Iowa.

A study of factors which influence the dispersibility and sedimentation of clays from strata of three older glacial drifts. Notes that a definite critical concentration of barium ions is necessary to produce flocculation and sedimentation. The relation between the Tyndallbeam intensity and the pH was determined for various glacial tills. Studies the mutual influence of hydrogen ion concentration and of electrolytes upon the stability of colloiddally suspended Pleistocene clays.
- GRAHAM, JAMES C.
1. On peculiar method of sand-transportation by rivers. Amer. Jour. Sci., (ser. 3), vol. 40, no. 240, p. 476, Dec. 1890; [abstract], Sci. Amer., vol. 64, no. 2, p. 21, Jan. 10, 1891.

Notes the occurrence of sand transportation upon the surface of water, due to capillary floating, and describes a method of removing sand from a bar jutting out from an island in the Connecticut River. The floating sand phenomenon offers a possible explanation for the occurrence of coarser sand particles in very fine deposits.
- GRANGER, C. W.
1. The C. C. C. and soil conservation in the Southwest. Soil Conserv., vol. 2, no. 8, pp. 161-164, 173, illus., Feb. 1937.

GRANGER, C. W. - Continued

In addition to a description of the work of the C. C. C. in soil conservation in the Southwest, gives a brief agricultural history of the Rio Grande basin. Describes reduction of flood hazard by flood control and irrigation works. Notes the economic value of Elephant Butte Reservoir. Discusses danger to this reservoir, by sedimentation, noting that in 20 yr. the reservoir storage was depleted 13.84 percent. The accumulation of silt resulted from overgrazing and denudation of vegetative cover on the watershed. States that if vegetative cover can be brought back, only a relatively small amount of silt will find its way into the Rio Grande.

GRANT, A. P.

1. Channel improvements in alluvial streams. New Zeal. Inst. Engin., Proc., vol. 34, pp. 231-279, illus., 1948. Reprinted as Tech. Bul. (restricted) no. 1 of the New Zeal. Soil Conserv. and Rivers Control Council.

Considers the channel-improvement aspect of river control. Treats such subjects as bed load and its influence on channels, meandering, regime formulas, stream-bank protection, artificial cuts, radius of curvature, improvements to channels, groynes and bank stabilization. Considers improvements to alignment by artificial cut-offs or training works. The paper is followed by discussions of the article by various individuals.

GRANT, BURTON S.

1. Erosion control in Los Angeles watersheds. Amer. Waterworks Assoc. Jour., vol. 39, no. 12, pp. 1224-1228, Dec. 1947.

Discusses erosion in watersheds adjacent to Los Angeles and its relation to the water-supply system. The worst silting problem is at Dry Canyon Reservoir where sediment has been removed by dredging. Sixteen debris basins have been constructed in the vicinity of Los Angeles. These held back 690,000 cu. yd. of material during the 1938 flood.

GRANT, KENNETH C.

1. Fertilizing bottom lands with flood water [abstract]. Engin. Soc. Pa. Jour., vol. 7, pp. 264-267, 1915.

A report prepared by the Royal Academy of Architecture of Prussia presenting results of experiments to determine the practicability of admitting fertilizing silt-laden flood water into bottom lands behind levees of the lower Rhine, the lower Ems, and the lower Oder.

GRANTHAM, RICHARD FUGE

1. The drainage of the fens. Engineering, vol. 96, pp. 202-203, illus., Aug. 1913.

Describes the reclamation of the fens, England, by improving the drainage. Notes that, between the fens and the sea, the soils of the marshes were partly derived from silt and soils carried down by streams. Improvements in the drainage of the fens resulted in settling of fens and marshes. While settlement was in progress, silting up of the bed of rivers took place thereby increasing flood hazards. Recommends remedying situation by (1) clearing out and deepening rivers, or by (2) pumping at the outfall of the drains.

2. The effect of sluices and barrages on the discharge of tidal rivers. Engineering, vol. 112, no. 2898, p. 130, July 15, 1921.

Describes some experiences and notes several opinions regarding the effects of the establishment of sluices or barrages upon conditions of silting in the channels of tidal rivers.

GRASSY, RICHARD G.

1. Instructions for labeling samples sent to the sedimentation laboratory. U. S. Soil Conserv. Serv., Sedimentation Div., Tech. Let. Sed-11, 6 pp., illus., Feb. 28, 1940.

Presents instructions for labeling samples sent to the sedimentation laboratory. Illustrates various types of labels.

2. Staining natural river sands for studies of sediment movement. Civ. Engin., vol. 11, no. 11, pp. 668-669, illus., Nov. 1941.

Describes method of studying bed-load movement in hydraulic models and small streams by

introducing or emplacing colored sands in the bed of the model or stream. Measurement of depth of scour may be made and in some cases the movement of bed load from point of scour to point of deposition may be traced. Describes method of staining.

3. Use of turbidity in estimating the suspended load of natural streams. Amer. Waterworks Assoc. Jour., vol. 35, no. 4, pp. 439-453, illus., Apr. 1943.

Discusses the use of turbidity determinations for estimating the suspended loads of streams, and shows that the relation of turbidity to suspended matter in the Enoree River, S. C., follows a definite pattern. Describes the investigation and gives results and conclusions of the study. Notes that in future suspended load investigations, turbidity measurements supplemented by a few gravimetric determinations, may cut laboratory costs considerably.

4. Use of microprojector in the mechanical analysis of small samples of river sand. Jour. Sedimentary Petrology, vol. 13, no. 2, pp. 47-57, illus., Aug. 1943.

Describes a method by which the size distribution of very small samples may be determined by microprojection. Test analyses of four sands indicate that data so obtained are comparable with data obtained by sieve analysis. Points out that this method has been used extensively for textural analysis of suspended-load samples, and can be used whenever sufficient material is not available for sieve analysis.

GRAVES, EUGENE A. See Matthes, G. H., 6.

GRAVES, HENRY S.

1. Forestry in relation to city water supplies. Conn. Soc. Civ. Engin., Papers and Trans., 1903, pp. 86-98, 1904.

Deals with forestry from a business standpoint and considers the influence of forests on the volume of discharge of water, on the regularity of discharge of water, and on the purity of the water supply. Notes the effect of forests in keeping silt from feeding canals and reservoirs.

2. The South's forestry and water resources. Amer. Forestry, vol. 20, no. 5, pp. 377-379, May 1914. Discusses the effect of denudation of mountain slopes upon the water resources of the Southern Appalachian region. Includes two paragraphs noting the effect of sediment deposition in stream channels and reservoirs upon navigation and water-power development.

GREAT BRITAIN, DEPT. OF SCIENTIFIC AND INDUSTRIAL RESEARCH.

1. Effect of discharge of crude sewage into the estuary of the River Mersey on the amount and hardness of the deposit in the estuary. Gt. Brit., Dept. Sci. and Indus. Res., Water Pollut. Res., Tech. Paper 7, 337 pp., 1938; [abstracts], Sewage Works Jour., vol. 10, no. 4, pp. 802-803, July 1938; Inst. Munic. & County Engin., Jour., vol. 65, no. 5, pp. 346-348, Aug. 16, 1938.

An investigation to determine the effect of the discharge of crude sewage into the River Mersey estuary on the amount and hardness of the deposit in the estuary. Studies were made of the effect of admixture of sewage to saline suspensions of river mud on the rate of sedimentation. Concludes that the crude sewage discharged in the River Mersey estuary has no appreciable effect on the amount and hardness of deposits in the estuary.

GREELEY, JOHN R. See Hubbs, C. L., 1.

GREEN, HENRY

1. A photomicrographic method for the determination of particle size of paint and rubber pigments. Franklin Inst. Jour., vol. 192, no. 5, pp. 637-666, Nov. 1921.

Describes a photomicrographic method of determining the diameter of paint and rubber pigments. The particles are magnified, enlarged by means of a stereopticon, and measured on the projecting screen. Notes that the harmonic mean of the diameters may be used in the measuring of grains of marked elongation or flattening.

GREEN, RUTGER B. See Grunsky, C. E., 1.

GREENE, C. W.

1. Stocking policy for the waters of the Delaware and Susquehanna watersheds and discussion of fish management policies. N. Y. State Conserv. Dept., Ann. Rpt., (1935), vol. 26, sup., pp. 20-44, illus., 1936.

Discusses the stocking policy for waters of the Delaware and Susquehanna watersheds, the factors basic to a stocking policy, and stocking and other management policies for the more important streams of the area. Includes a discussion on effects on the streams of the flood of July 7, 1935, the conditions of scour and deposition, and their effects upon fish life.

GREENE, CHARLES E.

1. Water as a source of engineering difficulty. Mich. Assoc. Surveyors and Civ. Engin., Proc., pp. 32-46, Jan. 1883.

Discusses various engineering problems associated with the control of water. Includes brief discussion on current action in rivers; and describes conditions of bank erosion in 1880 on the Missouri River at Covington, Iowa.

GREENE, D. M.

1. Report . . . Feb. 1, 1878. Troy, N. Y., Water Commrs., Ann. Rpt. (1877) 23, pp. 94-132, 1878. Deals with the proposed damming of the Hudson River at Troy, N. Y. for navigation improvement. Includes discussion on conditions of transportation and deposition of suspended solid material in the stream, condition of deposition in the State reservoir near Lansingburg, and the effect of flow of turbid Mohawk River water into the Hudson.

GREGORY, HERBERT E.

1. Geologic sketch of Titicaca Island and adjoining areas. Amer. Jour. Sci., (ser. 4), vol. 36, no. 213, pp. 187-213, illus., Sept. 1913.

Describes the geology of Lake Titicaca and its surrounding areas in the Andean Plateau of southern Peru and northern Bolivia. Discusses the character and quality of lake water and the fluctuations in water level, the reclamation of Titicaca coast by stream-borne sediments, and formation of deltas at mouths of tributaries.

2. Note on the shape of pebbles. Amer. Jour. Sci., (ser. 4), vol. 39, pp. 300-304, Mar. 1915. Discusses the factors involved in the shaping of pebbles. Results of observations are reported.

3. The formation and distribution of fluvial and marine gravels. Amer. Jour. Sci., (ser. 4) vol. 39, pp. 487-508, May 1915. An analysis of the physiographic features resulting from ocean and river work as related to the deposition of gravel. Outlines the methods and given results of stream work as agents of erosion and deposition as affected by varying environmental conditions. Discusses, in this connection, the comparative rates of subaerial and marine erosion giving estimates of land surface reduction for the United States. Weathering, factors affecting the transportation of weathered material, conditions of deposition, and distribution and preservation of river gravels during a single physiographic cycle are noted. Reports conditions on the Urumba River, Peru, Chinli Creek, Ariz., Nile River Delta, and in the Triassic, England. Describes the effect of tectonic and climatic fluctuations on stream gradients and gravel deposition during interrupted physiographic cycles, and the interstratification of river gravels with marine sediment at river mouths.

4. The Navajo country. U. S. Geol. Survey, Water-Supply Paper 380, 219 pp., illus., 1916. Deals with the utilization and control of waters of the Navajo country, Ariz., N. Mex., and Utah. Includes brief discussion on the silt problem of streams in the Navajo country which necessitate consideration prior to the location and construction of irrigation works; notes that silt studies at Zuni reservoir, where conditions are similar to those in the Navajo country, indicate that during eight years after construction of the reservoir there was an annual average of 531 acre-feet deposit of silt.

5. The San Juan country, a geographic and geologic reconnaissance of southeastern Utah. U. S. Geol. Survey, Prof. Paper 188, 123 pp., illus., 1938. Deals with the geography and geology of the San Juan country in southeastern Utah. Includes a brief discussion on the rate of denudation in the region.

GRESSWELL, R. KAY

1. Rivers and their formation. Nature, vol. 140, no. 3542, pp. 496-97, Sept. 18, 1937. Comments briefly on the formation of rivers. Treats the load of streams, and transporting and erosive ability of the streams. Notes effect of rejuvenation on a meandering stream.

GRIBBIN, W. See Borer, O., 1.

GRIER, N. M.

1. The streams of Long Island. Science n. s., vol. 58, no. 1492, p. 86, Aug. 3, 1923.

Gives the causes for the differences between the west and east banks of the rivers of Long Island. Comments on conclusions by Jennings, Hays, and Davis and notes that observations indicate that cumulative effects of wind and vegetation upon wind-borne materials explain in large part at least the steeper west bank of Long Island streams.

GRIFFIN, L. E.

1. Experiments on tolerance of young trout and salmon for suspended sediment in water. Oreg. State Dept. Geol. and Min. Indus., App. B, pp. 28-30, illus., 1938.

Reports experiments conducted at Reed College to determine the degree of tolerance of young trout and salmon for suspended sediment in water. Describes kinds of fish, material used for sediment, and experimental procedure. Conclusions indicate that fish for definite periods of time are not harmed by living in sediment-laden waters.

GRIFFITH, WILLIAM MAURICE. See also Lane, E. W., 4.

1. A theory of silt and scour. Inst. Civ. Engin., Minutes of Proc., vol. 223, pp. 243-263, illus., 1927; [abstracts], Engineering, vol. 123, p. 72, Jan. 21, 1927; Engin. and Contract., vol. 66, no. 2, pp. 80-81, Feb. 1927.

Deals with the theory of silt and scour. Discusses the silt-transporting power of a stream as a function of velocity and depth, and notes R. G. Kennedy's observations of Punjab irrigation canals where no silting or scouring occurred when mean velocities bore a certain relationship to the depth. Discusses Kennedy's value of n ; laws regarding silt transportation, deposition and scouring of bed; stability of streams flowing through alluvial plains (India); and effect of velocity and slope on silting and scouring, including formulas. Notes the building up of the beds of the Ganges and Jumna Rivers by the flood of October 1924. Gives detailed discussions of marginal erosion at bends; transporting power of bed movement; effect of depth of canal on silt-carrying capacity; effect of contraction of width of stream on scouring ability; observations and formulas; and applicability of the theory to the design of bridge foundations and to river training.

Discussion: FREDERICK PALMER, p. 264, notes the value of Kennedy's work in eliminating silt and scour from canals in India and the value of the theory to builders of piers and bridges. THOMAS R. J. WARD, pp. 264-268, considers the work of Mr. Kennedy in the Punjab on the design and construction of canals to eliminate silt and on the use of the "critical velocity ratio." Use of the Kennedy formula with the critical velocity makes a channel broad and shallow at the head and narrower and deeper away from the head. The effect of flood height on bed level in the Yellow and Tigris Rivers is discussed. A reference is cited. F. W. WOODS, pp. 268-273, notes the applicability of Kennedy's formula to artificial canals and not to rivers of unstable regime. Discusses the silt-transporting power of a stream as a function of mean velocity, depth, width and location of the point of maximum velocity relative to the width of the section; and the laws of

scour, silt transportation, and silt deposition with reference to the bed of a river. E. P. ANDERSON, pp. 273-275, considers the value of the theory and makes observations on floods and scour in relation to bridge design and construction. SIDNEY PRESTON, pp. 275-276, comments on F. W. Woods' discussion relative to the effect of side slopes in calculating cross sections of canals. THE AUTHOR, pp. 276-280, comments on discussions of Messrs. Ward and Woods regarding factors affecting the silt-transporting power of streams. Discusses the general applicability of law dependent upon required existing conditions. R. E. BALLESTER, pp. 280-282, notes that Kennedy's formula is not applicable to all water courses. Gives observations applying Kennedy's law to irrigation canals of the Rio Negro Superior, Argentina. A table shows the fineness of silt deposited in the main canal of the Rio Negro irrigation works. Observations on the silt content of Neuquen irrigation works are also given in a table. Observations on silt content of the Neuquen River at Punto Unido, during floods of May 17-20, 1918 and May 7-13, 1919, and at Neuquen Barrage during the flood of May 23-29, 1915, showed that for the same water stage the silt content varied for different floods with the height of the flood wave and with the river stage, and that the maximum silt content was reached before the maximum river stage (graphs). E. S. BELLASIS, pp. 282-284, comments on variations of d in Kennedy's formula and states that no formula could suit all channels. Notes that a flood might leave a section silted or scoured. P. CLAXTON, pp. 284-285, comments on Griffith's use of an empirical formula for flow and states that the laws of flow are governed by the restraint of the boundary and potential energy inherent in particles of silt which have been deposited on the upstream face of dunes on the bed of the stream. Notes that each grade of silt gives a distinct formula. K. O. GHABLEB, pp. 285-287, makes observations on the adaptation of Kennedy's law to Egyptian canals. GORDON HEARN, pp. 287-291, considers the applicability of the theory to the design of bridge foundations and to river training. GERALD LACEY, pp. 291-294, comments on the need for re-examination of the problem of silt transportation, with special reference to streams in fine silt and with consideration of the mean hydraulic depth. Kennedy's value of d is mere guesswork in deducing critical velocities from observations on channels in a natural regime. Accurate calculation in terms of r (mean hydraulic radius) instead of d presents little difficulty in the problem of the silt-carrying capacity of a channel in fine silt when the section is semi-circular. It is to such a section that rivers in fine silt and mud tend to approximate. J. M. LACEY, pp. 294-296, considers the silt-transporting power of a stream, and notes that it should depend on the ratio of maximum velocity and not on the magnitude of velocity alone. Discusses the relationship between the velocity and depth of streams relative to silt transportation. Notes that in the case of a weir the velocity of approach enables a river or stream to scoop silt up in front of the weir. Velocity depends on the depth and slope of the stream, not on the ratio between width of river and width of weir. E. S. LINDLEY, pp. 296-297, comments on Griffith's discussion of the silt-transporting power of a stream as a function of velocity and depth based on R. G. Kennedy's relation for critical velocity and depth. J. S. OWENS, pp. 297-299, considers the inclination of repose of saturated material; the velocity of current required to move particles of sand or stone; and the rolling of stones over the bottom of the stream. R. L. PARSHALL, p. 299, requests the presentation of original data secured by R. G. Kennedy in arriving at the value of $n=0.64$. R. E. PURVES, pp. 299-302, notes the advantage of connecting Kutter's formula of flow with Kennedy's formula of silt-equilibrium

Gives observations relative to scouring and silting of a canal in the vicinity of a weir at Khanki, India, during the flood of the Chenab River in 1903. Checked by Kennedy's silt equation, scour depth was 50 percent greater than was necessary for silt equilibrium. J. A. SPRECKLEY, p. 302, notes the possibilities of extending Kennedy's formula and Griffith's corollaries to conditions that occur in flat streams which form the outlets of certain lakes in western Canada where the conveyed silt-content was negligible after passing through a lake or series of lakes. Mentions the effect of vegetation on scouring velocity. E. F. SYKES, pp. 302-303, notes the consideration by Griffith of Kennedy's coefficient as meaningless since it is based on particular periods of time and not on a yearly basis as Kennedy intended it to be. Notes that the theory is not applicable to complex cases presented by rivers in flood. EDGAR C. THRUPP, pp. 303-305, takes exception to Griffith's value of n , C , and r , noting that any general formula for movement of silt should be able to represent the required velocities for different depths and a constant silt-ratio. Discusses the effect of velocity and slope on silting and scouring. W. L. C. TRENCH, pp. 305-307, takes exception to Mr. Kennedy's mathematical expressions on velocities required to produce motion in materials of various grades. Compares the curve of silting and scouring conditions for the Jamrao Canal, Sind, with Kennedy's curve. Notes that C in Kennedy's formula might be altered by changes in the physical characteristics of rolling silt rather than conform to a variation in the slope of the stream bed. THE AUTHOR, pp. 307-314, replying to correspondence, notes that the theory advanced was based on the observation that if the velocity of flow at any point in the section considered was reduced, the depth automatically decreased, and vice versa. The law of critical velocity must follow the law of flow for all depths. Notes variations, brought out by correspondents, of V_o (mean velocity) in Kennedy's formula for irrigation canals in different countries depending on silt content (c) of the stream. Reaffirms deductions that the ratio of maximum scour to depth of the approaching stream was independent of the nature of the material forming its bed. Notes that shortening of the course of a river by short-cutting of a loop led to scour at that point and silting of the reach below, while lengthening in one reach would reduce silting in the reach below.

2. A theory of silt transportation. Amer. Soc. Civ. Engin., Trans., vol. 104, pp. 1733-1748, illus., 1939; Also in Amer. Soc. Civ. Engin., Proc., vol. 64, no. 5, pp. 859-874, illus., May 1938; [abstract], Iowa Univ. Studies in Engin., Bul. 19, p. 61, May 1939.

Outlines a theory of silt transportation and presents equilibrium equations for use in river-control engineering works when specific hydraulic conditions exist. Presents a general theory of silt transportation applicable when silt load and bed consist of loose granular material and flow is turbulent and follows boundary surfaces. Develops equations of stability in connection with river control works and tidal outfalls. Checks equations with observed data on the distribution of silt in cross section in Imperial Valley canals, Dahlia Canal, various other canals, and the Colorado River at Yuma, and on variations in silt content at tidal outfall of the Great Ouse River. Application of the theory is discussed.

Discussion: JOE W. JOHNSON, pp. 1749-1752, presents calculated and observed silt content in vertical sections, analysis of silt distribution in the Rivers Po and Reno, Italy, and in the Brazos River, Tex. Gives a summary of observed and computed silt load in various rivers and canals, and in flume studies at the U. S. Waterways Experiment Station. Discusses briefly the relationship between discharge and silt load of streams. G. W. HOWARD, pp. 1752-1754, questions the applicability of

- Griffith's theory to other rivers. Cross-sectional distribution of silt in Mithrao Canal, India, is discussed, noting that results indicate indefinite tendencies for the movement of silt. HARRY F. BLANEY, p. 1754, notes the value of Griffith's theory on silt transportation in estimating silt loads carried by streams for the proper design of irrigation and flood control works in the Southwest. Presents additional data on silt distribution in No. 5, Main Canal, and East Highline Canal, Imperial Valley, Calif. E. W. LANE, pp. 1755-1756, comments on Griffith's use of the Chezy equation as applied to open channels, and discusses the effect of both size and quantity of material carried as factors affecting the shape of channels in erodible material. O. A. FARIS, pp. 1756-1757, believes that Griffith's theory is inapplicable to the streams of Texas. States that in Texas streams observations indicate that the magnitude of the silt charge carried appears to be a function of the loading and not of the capacity to carry. J. E. CHRISTIANSEN, pp. 1757-1760, considers Griffith's theory of silt transportation, the basic Kennedy formula, theory of silt distribution of Schmidt and O'Brien, and Lane's correlation between material transported in suspension and discharge of a given stream. SAMUEL SHULITS, pp. 1760-1761, notes the uncertain practical application and reliability of Griffith's formula for elementary law of silt transportation. GERALD LACEY, pp. 1761-1764, criticizes the use of mean depth as a variable in Griffith's equations and his reliance on a doubtful interpretation of the Chezy formula. Traces briefly the historical development of the silt transportation subject by Kennedy, Howley, Lacey, and others. GLENN W. HOLMES, pp. 1764-1767, notes that Griffith's assumptions relative to his theory on silt transportation would not be found valid in practice. States that no simple formula involving such factors as velocity and depth will be found to define silt loads of any particular size or range of sizes, because those factors do not, and cannot, regulate or indicate the rate of debris supply, largely soil erosion. Presents, in this connection, data relative to mechanical analysis of silt samples collected by the U. S. Geological Survey and the U. S. Soil Conservation Service on Coon Creek, and Little La Cross River, Wis., and West Fork on Deep River, N. C., also data on sediment distribution in various lakes and reservoirs from Silting of Reservoirs (Eakin, H. M., 9). HUNTER ROUSE, pp. 1767-1768, states that Griffith's equation for elementary law of silt transportation is arbitrary and lacks a sound physical basis. S. G. BAUER, pp. 1768-1769, takes exception to Griffith's assumptions relative to factors affecting the shape of a stable channel in erodible material. C. C. INGLIS, pp. 1769-1771, criticizes Griffith's formulas since assumptions are based on Kennedy's formula which is a rough approximation. Presents Lacey's formulas giving dimensions for regime channels. THE AUTHOR, pp. 1771-1786, presents a more complete explanation of the theory in answer to misunderstandings in previous discussions and adds another equation to show that deductions from the theory may be checked with observed natural phenomena. Comments on previous discussions.
3. Silt transportation and its relation to regime channel sections [abstract]. *Inst. Civ. Engin., Jour.*, vol. 22, no. 6, pp. 107-120, Apr. 1944. Maintains that changes in the cross sections of rivers and canals resulting from changes in hydraulic conditions can be calculated mathematically from a basic law. Gives tables of hydraulic data for various rivers. Suggests three necessary conditions to secure regional sections for irrigation channels.
 4. Further notes on silt transportation. *Inst. Civ. Engin., Jour.*, vol. 27, no. 1, pp. 67-81, Nov. 1946. A mathematical treatment of the silt transportation problem. Gives principal formulae already developed by the writer concerned with silt transportation. Presents equations for bed-load transportation. Compares observed silt loads with calculated silt loads.
- Griffiths, J. C. See Brotherhood, G. R., 1.
- GRIGGS, ROBERT F.
1. The Buffalo River: An interesting meandering stream. *Amer. Geog. Soc. Bul.*, vol. 38, no. 3, pp. 168-177, illus., 1906. Describes conditions of meandering of the Buffalo River, Minn., and theorizes upon the factors controlling the meandering of streams.
- GRIM, RALPH E. See also Lamar, J. E., 1.
1. The petrographic study of clay minerals - A laboratory note. *Jour. Sedimentary Petrology*, vol. 4, no. 1, pp. 45-46, Apr. 1934. Describes a technique for obtaining aggregates of clay mineral particles in which the particles have almost the same optical orientation in order to measure the optical constants of the clay mineral. Deals with the problem of fine calcite which masks the optical constants of clay.
 2. Properties of clays. In Trask, P. D., ed. *Recent marine sediments*, a symposium, pp. 466-495, illus. London, T. Murby and Co., 1939. Considers the optical, chemical, base-exchange, dehydration and lattice structural characteristics of the clay minerals. Points out that there are three main groups of clay minerals, illite, kaolinite, and montmorillonite. States that clay mineralogy should be considered in the making and interpreting of mechanical analyses of argillaceous materials.
 3. Modern concepts of clay minerals. *Jour. Geol.*, vol. 50, no. 3, pp. 225-275, illus., Apr.-May 1942. Summarizes the occurrence of clay minerals in soils, sediments, shales, and clays. Presents pertinent information on the structure, composition, and other properties of clay minerals. Suggests new interpretations.
- GRIMM, C. I. See Hall, W. M., 1.
- GRIPENBERG, STINA
1. Mechanical analysis. In Trask, P. D., ed. *Recent marine sediments*, a symposium, pp. 532-557, illus. London, T. Murby and Co., 1939. On the theory and practice of mechanical analysis of sediment. Dispersion of sand grains is accomplished by freeing them of their covering of colloidal material or organic matter. Preliminary treatment of sediment is designed to make all its particles behave like sand grains, best achieved by saturation with highly hydrated ions and subsequent removal of excess electrolytes. Five methods of dispersion are given. Stokes' law is valid for analysis of sizes under 50 microns, above that Oseen's equation must be used. Analysis can be made by separating material into size fractions by use of sieves, elutriation and decantation, or by computing size fractions from analytical data without separation. Procedure and equipment used in making the determination are described. Wiegner's sedimentation tube and Oden's automatic balance are given as methods based on sedimentation curve; this curve is interpreted in terms of grain sizes.
- GROAT, B. F. See Freeman, J. R., 3.
- GROSBY, B. L. See Ockerson, J. A., 4.
- GROSBY, IRVING B.
1. Methods of stream piracy. *Jour. Geol.*, vol. 45, pp. 465-486, illus., 1937. Discusses the methods of stream piracy and analyzes the two prevalent theories relative to the final act of piracy. Considers the capture of surface streams by surface streams or by subterranean tributaries of surface streams. Factors governing capture are analyzed.
- GROSS, JOHN
1. (and Zimmerly, S. R.). Surface measurement of quartz particles. *Amer. Inst. Mining and Metall. Engin., Tech. Pub.* no. 46, 16 pp., illus., 1929. Develops a method for surface measurement of quartz which depends on the rate of dissolution in hydrofluoric acid; gives surface measurement of quartz within 5 percent of true value.
- GROSSMAN, K. H.
1. Theoretische betrachtungen zum Geschiebetrieb (Theoretical consideration of bed-load movement). *Schweiz. Bauzeitung*, vol. 110, no. 14, Oct. 2, 1937. In German. Translation on file at the U. S. Soil Conservation Service, Washington, D. C., and the California Institute of Technology, Pasadena, Calif.

- Discusses the movement of bed load, giving various equations and a theoretical consideration of the problem. Outlines various theoretical assumptions of the bed-load movement problem.
- GROVER, NATHAN C. See also Larson, H. T., 1; Stevens, J. C., 2; Anonymous, 147.
1. Standing waves in rivers. *Amer. Soc. Civ. Engin. Trans.*, vol. 85, pp. 1400-1404, 1922.
Describes causes and characteristics of standing waves in rivers, hydraulic jump, sand wave, tidal bore, and standing flood wave. Includes discussion of sand waves, their occurrence, causes, characteristics, and conditions of movement. Sand waves observed by R. C. Pierce in the San Juan River in southern Utah are briefly described.
 2. Grazing exerts only minor effect on erosion [letter to editor]. *Civ. Engin.*, vol. 3, no. 4, p. 236, illus., Apr. 1933.
Comments on Professor Chapman's article on control of grazing to control soil erosion (Chapman, H. H., 3). Notes that there is no evidence showing that sediment load of Colorado River varied in last four centuries. The Colorado River carries through the Grand Canyon a yearly average of about 260,000,000 tons of material in suspension. Concludes that control of grazing is desirable and any control of soil accomplished thereby would be beneficial.
 3. Stream flow, suspended and dissolved matter in streams on and near soil conservation project, High Point, North Carolina. 39 pp. Washington, U. S. Geol. Survey, 1936.
Study made in cooperation with U. S. Soil Conservation Service on measurements of stream flow, suspended and dissolved matter in stream on and near the High Point Project, N. C. Includes tables showing distribution of loads of suspended matter by days, and daily discharge and daily loads of suspended matter of West and East Forks of Deep River near High Point, N. C., Deep River near Randleman, N. C., Muddy Creek near Archdale, N. C., Uharie River near Trinity, N. C., and Horsepen Creek at Battleground, N. C.
 4. Stream flow, suspended and dissolved matter in streams on and near soil conservation project, La Crosse, Wisconsin. 21 pp. Washington, U. S. Geol. Survey, 1936.
Study made in cooperation with the U. S. Soil Conservation Service on measurements of stream flow, suspended and dissolved matter in streams on and near the La Crosse Project, Wis. Includes tables showing distribution of loads of suspended matter by days, and daily discharge and daily loads of suspended matter of Little La Crosse River near Leon, Wis., Coon Creek at Coon Valley, Wis., and Coon Creek near Stoddard, Wis.
 5. Stream flow, suspended and dissolved matter in streams on and near soil conservation project, Mankato, Kansas. 48 pp. Washington, U. S. Geol. Survey, 1936.
Study made in cooperation with U. S. Soil Conservation Service on measurements of stream flow, suspended and dissolved matter in streams on and near the Mankato Project, Kans. Includes tables showing distribution of loads of suspended matter by days, and daily discharge and daily loads of suspended matter of East Limestone Creek and Elm Creek near Ionia, Kans., East Limestone Creek at Ionia, Kans., West Buffalo Creek near and at Jewell, Kans.
 6. Stream flow, suspended and dissolved matter in streams on and near soil conservation project, Pullman, Washington. 33 pp. Washington, U. S. Geol. Survey, 1936.
Study made in cooperation with U. S. Soil Conservation Service on measurements of stream flow, suspended and dissolved matter in streams on and near the Pullman Project, Wash. Includes tables showing distribution of loads of suspended matter by days, and daily discharge and daily loads of suspended matter of South Fork of Palouse River above Paradise Creek near Pullman, Wash., South Fork of Palouse River at Pullman, Wash., Paradise Creek near Pullman, Wash., Dry Fork of South Fork of Palouse River at Pullman, Wash., Missouri Flat Creek at Pullman, Wash., and Fourmile Creek at Shawnee, Wash.
 7. Stream flow, suspended and dissolved matter in stream on and near soil conservation project, Spartansburg, South Carolina. 40 pp. Washington, U. S. Geol. Survey, 1936.
Study made in cooperation with the U. S. Soil Conservation Service on measurements of stream flow, suspended and dissolved matter in streams on and near the Spartansburg Project, S. C. Includes tables showing distribution of loads of suspended matter by days, and daily discharge and daily loads of suspended matter of North Tiger River near Moore, S. C., South Tiger River near Reidville and Woodruff, S. C., and Tiger River near Woodruff, S. C.
 8. Stream flow, suspended and dissolved matter in streams on and near soil conservation project, Stillwater, Oklahoma. 33 pp. Washington, U. S. Geol. Survey, 1936.
Study in cooperation with the U. S. Soil Conservation Service on measurements of stream flow, suspended and dissolved matter on and near the Stillwater Project, Okla. Includes tables showing distribution of suspended matter by days, and daily discharge and daily loads of suspended matter of Stillwater Creek at Stillwater, Okla., West Fork of Brush Creek and Council Creek near Stillwater.
 9. Stream flow, suspended and dissolved matter in streams on and near soil conservation project, Tarkio-Bethany, Missouri. 62 pp. Washington, U. S. Geol. Survey, 1936.
Study made in cooperation with U. S. Soil Conservation Service on measurements of stream flow, suspended and dissolved matter in streams on and near the Tarkio-Bethany Project, Mo. Includes tables showing distribution of loads of suspended matter by days, and daily discharge and daily loads of suspended matter of East Tarkio Creek at Blanchard, Iowa, West Tarkio near Westboro, Mo., and East Fork of Big Creek near Bethany, Mo.
 10. Stream flow, suspended and dissolved matter in streams on and near soil conservation project, Temple, Texas. 27 pp. Washington, U. S. Geol. Survey, 1936.
Study made in cooperation with U. S. Soil Conservation Service on measurements of stream flow and suspended and dissolved matter in streams on and near the Temple Project, Tex. Includes tables showing distribution of loads of suspended matter, by days, and daily discharge and daily loads of suspended matter of Deer Creek, Chilton, Tex., Big Elm Creek, Buckholts, Tex., and North Elm Creek at Ben Arnold, Tex. Tables indicate that a large proportion of total yearly load of suspended matter is carried during comparatively short periods of time. Includes table giving analyses of dissolved mineral matter.
 11. United States Geological Survey records of suspended and dissolved matter in surface-waters. *Amer. Geophys. Union. Trans.*, vol. 17, pt. 2, pp. 444-446, July 1936.
Describes types of reports, dates of publication, subjects reported, and location of observations. Water-Supply Paper numbers of the reports are given.
 12. (and Howard, Charles S.). The passage of turbid water through Lake Mead. *Amer. Soc. Civ. Engin. Trans.*, vol. 103, pp. 720-732, illus., 1938; Also in *Amer. Soc. Civ. Engin., Proc.*, vol. 63, no. 4, pt. 1, pp. 643-655, illus., Apr. 1937.
Comments on the flow of turbid water through Lake Mead and its discharge at the dam with its characteristics unchanged at three different periods during 1935. Discusses conditions of transportation and deposition of sediment in the Colorado and effect of Boulder Dam on regimen of stream. Describes measurements and observations, Mar. 1 to Oct. 31, 1935, on quantity of material deposited in lake, scouring of channel between Willow Beach and Topock, sizes of particles of suspended matter, rate of

settling, and dissolved and suspended load determinations in water entering into and discharged from lake. Conditions of inflowing water; specific gravity, and temperature, affecting the flow and discharge of turbid water are discussed. Notes significance of underflow phenomenon with respect to the possibility of increasing the passage of fine silt through a reservoir, thus prolonging its effective life. Discussion: O. A. FARIS, pp. 733-734, presents evidence that deposited silt flows down slopes of reservoir bottoms in the form of liquid mud. Describes conditions at Lake Kemp, Wichita Falls, Tex. and at Medina Reservoir, near San Antonio, Tex. Discusses conditions of consolidation of material deposited in reservoirs noting characteristics of samples taken from Lake Worth, near Fort Worth, Tex., and Lake Kemp. PAUL A. JONES, pp. 734-735, describes various topographic conditions affecting the flow of turbid water through Lake Mead during 1935. Notes conditions of shoaling in San Francisco Bay where colloidal silt of Sacramento River is precipitated when it comes in contact with saline water from the ocean at a considerable distance from mouth of stream. CARL S. SCOFIELD, pp. 735-736, notes briefly the factors affecting the depositions of silt in a reservoir and those affecting the flow of turbid water through a reservoir. IVAN E. HOUK, pp. 736-739, presents data on temperatures of water discharged from Lake Mead, Feb. 1 to Dec. 31, 1935, and discusses the flow of turbid water through reservoirs on a basis of temperature distribution within the lake. WILLIAM P. CREAGER, pp. 739-741, cites the conditions favorable to the flow of turbid water through a reservoir, the factors affecting the specific gravity of incoming water, and the influence of dissolved material entering Lake Mead on the discharge of silt during 1935. Discusses the suspended load at Lake Mead as a feature affecting discharge of suspended matter from the Lake on the basis of size of particles, total volume in suspension, and percentage of material in suspension. HAROLD K. PALMER, pp. 741-743, notes results of experiments by writer and A. M. Rown on the mixture of fresh water and sea water, and makes application of results to conditions of turbid flow through Lake Mead during 1935. MORROUGH P. O'BRIEN, pp. 743-744, gives possible explanation of the flow of turbid water through Lake Mead, based on theories dealing with the suspension of solids in turbulent flow. JOHN C. PAGE, pp. 745-747, presents further data obtained during 1935 by the U. S. Bureau of Reclamation on discharge of turbid water from Lake Mead, on elevation of silt-laden stratum, the silt content of discharge, and the temperature of water. Notes the physical characteristics of silt passing through Lake Mead. JOHN H. BLISS, pp. 747-751, describes occurrences of flow of turbid water through Elephant Butte Reservoir and at the San Acacia diversion dam (Rio Grande Project). Presents data relative to tributary discharges into Elephant Butte Reservoir, 1931-36. Results of study on the passage of silt through Elephant Butte Reservoir are given. Possible means of reducing silt accumulations in a reservoir by encouraging the flow of turbid waters are noted. B. H. MONISH, pp. 751-755, gives a mathematical analysis of recorded silt flows through Lake Mead and Elephant Butte Reservoir relative to the mixing of two superposed fluids of different densities (L. Prandtl). D. M. FORESTER, pp. 755-756, notes that flow of turbid water without apparent mixing occurs frequently in settling or clarification basins. Analyses of dissolved and suspended solids of the Colorado River water show wide variation between the inflow to Lake Mead and the outflow from Boulder Dam. This indicates little mixing action between inflowing water and water in the lake over a short period of time. Deposition in Lake Mead, Mar. 1 to Oct. 31, 1935 based on an average inflow and outflow of suspended solids

is given. Factors affecting flow of turbid water through a reservoir are noted. A. D. LEWIS, pp. 757-759, refers to Silting of Four Large Reservoirs in South Africa (Lewis, A. D., 2), wherein is described a method of removing a portion of incoming silt at Lake Arthur Reservoir by bottom-flow tapping. Analysis of silt passing through tap valves, association of bottom flow with flocculated clay, conditions of bottom flow with reference to concentration of flocculated particles, and effectiveness of bottom-flow tapping are considered. G. C. DOBSON, pp. 759-763, notes reservoir silting surveys by the Section of Sedimentation Studies, Division of Research, U. S. Soil Conservation Service, and discusses the distribution of silt in a reservoir as affected by the passage of silt-laden water through a reservoir. Describes observations on Elephant Butte Reservoir during 1935, noting that underflow conditions have a tendency to produce a level floor of silt in a reservoir in a comparatively short time. This feature was found also in San Carlos Reservoir, Gila River, Ariz., and Gibraltar Reservoir, near Santa Barbara, Calif. Notes conditions of the distribution of silt deposits in the Black Canyon Reservoir, Payette River, near Emmet, Idaho, and reservoirs of the Piedmont Region in the Southeast. WILLIAM W. RUBEY, pp. 763-767, cites the differences in density and velocity of two fluids and for complex gradational fluids, and reports that density gradients and velocity gradients in transitional layers are the controlling factors affecting density by currents. Discusses available data on suspended matter, salinity, and temperature for computing approximate densities of inflow and outflow from Lake Mead during 1935 (U. S. Geological Survey and Bureau of Reclamation). Notes the desirability of data on the degree of flocculation of sediment in incoming water and the velocity or slope of muddy currents in the investigation of conditions accompanying density currents. J. C. STEVENS, pp. 767-770, notes conditions of the discharge during 1935, of silt through Lake Mead and the Elephant Butte Reservoir. Cites experiments on the mixture of fluids of different densities at the University of California, the significance of density flow with reference to reservoir capacity, and the quality of water passing through reservoir as turbid flow. Notes need for cooperative investigations on the silt problems in the Colorado River and Rio Grande basins. C. S. JARVIS, pp. 770-771, considers turbid flow, the desilting of reservoirs with subsequent increase in soil fertility as a result of sluicing and spreading suspended load upon land surface. Discusses conditions of turbid flow through Elephant Butte Reservoir and Lake Mead and estimates that the total annual silt inflow to Lake Mead is 240,000,000 tons. The average load of suspended matter equals 1.07 percent weight of water. Value of desilting at Lake Mead, the silting problem of irrigation canals, and the effect of silt on turbines are noted. R. E. REDDEN, pp. 771-774, presents data on the passage of turbid water through Echo Reservoir, Utah, during flood of Aug. 6, 1934. Causes of watershed conditions conducive to mud flows are noted. Describes Weber River and Echo Reservoir, conditions of flood of Aug. 6, 1934, and characteristics of mud flow through the Reservoir. RAYMOND A. HILL, pp. 775-782, notes economic unimportance of turbid flows through Lake Mead and importance of phenomena which produce these flows. Presents data on the quality of Colorado River water and gives a geochemical interpretation of the relative variations in salinity of water entering and leaving Lake Mead, in 1935. Describes characteristics of turbid flows through Lake Mead and estimates quantity and character of water that carried silt through reservoir. Discusses minimum silt percentage necessary for turbid flow and conditions for passage of clear saline water through reservoir. THE AUTHORS, pp. 782-790, comment on the discussions of their paper by Faris, Page, Forester, Redden, Dobson, Lewis, Jones,

Scofield, Creager, Bliss, Stevens, Houk, O'Brien, Monish, Rubey, Jarvis, and Lewis. Present letter of S. B. Morris giving observations of turbid flow through Morris Reservoir, Calif. The reports of Carnegie Institute of Washington (Publications 450 and 480 by G. Sykes) on the nature of silt carried by the Colorado River, and the plans and work at San Carlos Reservoir and Coolidge Dam of the Interdivisional Committee on Density Currents, National Research Council are included in the discussion, likewise the observations by U. S. Bureau of Reclamation on movement, temperature, positions, and stratification of turbid water in Lake Mead, 1937-38. F. C. SCOBAY, (Amer. Geophys. Union, Trans., vol. 19, pt. 2, p. 661, Aug. 1938), considers the advisability of removing silt from the Colorado River by desilting processes noting effect of desilting on regimen of river bed at and below Yuma.

GRUNSKY, C. E. See also Cory, H. T., 2; Kelly, W., 1; Mead, E., 4; Rothery, S. L., 4.

1. The lower Colorado River and the Salton Basin. Amer. Soc. Civ. Engin., Trans., vol. 59, pp. 1-51, illus., 1907.

Discusses the geological trends of the formation of the Colorado River Delta with special reference to the recent large scale erosion of one of its passes, and the deposition of sediment in the direction of Salton Basin. Notes that these trends were foretold in accordance with the history of natural and artificial passes, and that they were demonstrated by the recent architectonic activity of the Colorado during recent floods. Reports that the Colorado carries seaward approximately 50 sq. mile-feet of silt annually. It is estimated that continuous discharge into Salton Basin will cause it to fill with silt resulting in a rise in bed level and causing a resumption of a southward flow. The direction of flow will be controlled by fluctuations in gradients.

Discussion: W. G. PRICE, pp. 52-53, comments on cutting away by water of silt deposits under a dam, and makes suggestions to alleviate this factor. RUTGER B. GREEN, pp. 53-54, examines briefly the natural architectonic activity of the lower Colorado. W. DE H. WASHINGTON, pp. 55-58, gives a description of the characteristics of the alluvial bottom of the Colorado River, the source of silt, and content of suspended material. Describes method of closing the break of the Colorado River formed in 1905 and the scouring power of the New or Alamo River. J. A. OCKERSON, pp. 58-60, states that a visit to the scene of the Colorado River break of 1906 disclosed, among other causes for break, a poor levee foundation; ground on which levee was constructed was composed of light soil, filled with cracks such as are found in silt deposits and caused by overflow. Notes damages to levee and attempts to stop flow. Condition of erosion at artificial intake to Salton Sea is described. Notes that closure of intake might be effected by fixing approaches to contemplated work, thereby stabilizing bed and banks against erosion. THE AUTHOR, pp. 60-62, includes two paragraphs noting that the Colorado River during 1900 brought down 61,000,000 tons of sediment (Forbes) and that the maximum silt content of the river during the spring flood of 1903 was 1.97 percent by weight (U. S. Reclamation Service, 1).

2. Solving the complex problem of the lower Colorado River. Jour. Elect. and West. Indus., vol. 47, pp. 143-144, illus., Aug. 15, 1921.

Deals with the proposed regulation of stream flow of the Colorado River by storage. Notes that the change in course of stream in 1909 toward and into Volcano Lake is resulting in the raising of the flood plain in the region at a rate of about 1 ft. per annum, thereby necessitating increased levee heights to prevent flood damages in the Imperial and Coachella Valleys.

3. Some factors affecting the problem of flood control. Amer. Soc. Civ. Engin., Trans., vol. 85, pp. 1488-1502, 1922.

Describes such factors on the White-Stuck and Puyallup Rivers, Wash., the San Gabriel and Los Angeles Rivers, Calif., and the lower Colorado River, noting conditions of silting and the transportation of detrital matter and drift. Discusses channel regulation and bank protection works, dam and levee construction, and provisions for the removal of silt and debris. Notes that silt contained in the Colorado River amounts to 0.8 percent by weight, equal to 112,000 acre-feet of compacted material, per year.

4. The head-works of the Imperial Canal. Amer. Soc. Civ. Engin., Trans., vol. 93, pp. 262-266, illus., 1929.

Describes improvements to the Imperial Canal by the construction of the Rockwood Gate intake structure and the extension of the canal upstream for about one mile. Discusses troublesome silt conditions at the regulating gate built in 1905 at the base of Pilot Knob; the use of a dredge to stir up silt to maintain capacity; and the silting in canals, laterals and ditches. Notes that suspended material in the water entering the canal averages about 8 percent and is estimated at an annual average of more than 14,000 acre-feet, 1915-27. Rockwood Gate was built to reduce incoming silt to a minimum and the extension to provide for the settling of some of the heaviest silt in suspension. Structural details of the headworks are given and distribution of silt in the cross-section of the Colorado is noted with reference to the arrangement of the intake.

Discussion: E. S. LINDLEY, pp. 267-269, gives methods of silt exclusion from canals in the Punjab, India, gate design and the distribution of silt in a channel cross section, and problems of headworks with a foundation on a previous bed. THE AUTHOR, p. 269, comments on a discussion by Lindley concerning the planning of off-take structures from silt-laden streams and the regulated drop of the gradient from stream to canal.

5. Silt transportation by Sacramento and Colorado Rivers and by the Imperial Canal. Amer. Soc. Civ. Engin., Trans., vol. 94, pp. 1104-1133, illus., 1930; also in Amer. Soc. Civ. Engin., Proc., vol. 55, no. 6, pp. 1473-1502, Aug. 1929.

Deals with the transportation of silt and detritus by the Sacramento and Colorado Rivers and the Imperial Canal. Observations on the Sacramento River and its tributaries are included. Discusses early gauging, conditions of silt transportation and deposition, river eccentricities, effect of mining detritus on streams, and conditions of river-bed alterations. Physical characteristics of Colorado River silt are described. Suspended silt-load determinations for the Imperial Canal are given for 1914, 1915, 1917 and 1918. Canal operation; conditions of silt transportation, deposition and removal; and character of deposited silt are described. Observations, 1914-20, to determine changes in elevation of the bed of the Imperial Canal, and surveys on volume of silt removed from head reaches, afford estimations of total volume of silt transported by the canal in suspension and as bed load. Estimates the amount of bed load of the Colorado River, basing estimates on bed-load determinations in the Imperial Canal. Data on silt carried in suspension by the Colorado River at Yuma, Ariz., 1909-27, are given. Discusses the value of data on silt determinations in explaining the distribution of silt in river cross-section, in explaining seasonal variations of the silt load at various river stages, and in determining total volume of transported material during the period of observation.

Discussion: C. S. HOWARD, pp. 1134-1136, summarizes data on silt-load determinations based on silt samples of Colorado River water collected at the Grand Canyon and Topock, Ariz., during 1925-28. HARRY F. BLANEY, pp. 1136-1140, describes the character of bed

silt in the Alamo Canal computations on the volume of suspended silt carried by the Colorado River, mechanical analysis of Colorado River and Imperial Canal silt at various depths, and the weight of suspended and dry deposited silt. Gives estimates of the average volume of silt which would be deposited in proposed reservoirs on the Colorado River based on various weights per cubic foot of silt. E. S. LINDLEY, pp. 1140-1142, considers the stability of rating curves as applied to the Indus and its tributaries in the Panjab, India. Describes observations attempting to establish a dependable value for Kutter's n noting Buckley's relationship between value of n and silt charge carried by stream flow (Buckley, A. B., 1). Refers to origin of boils on water surface and observations of dune movement in canal beds.

THOMAS MERRIMAN, pp. 1142-1144, points out the relationship between bottom load of the Colorado River and variations in river discharge. Notes the necessity for complete knowledge of the total silt load of the Colorado River in connection with engineering works centered about its waters. IVAN E. HOUK, pp. 1144-1150, considers various river phenomena such as sand waves, boils, and pulsations. Describes conditions of sand movement in waves in the settling basin at Fort Laramie Canal intake, North Platte Irrigation Project, Wyo.; and investigations at the Miami and Erie Canal at Dayton, Ohio, on the relationship between boils and pulsations, their effect on discharge measurements, and the effect of moss growth in this canal. Grunsky's estimates of 25,000-30,000 acre-feet as the bed load of the Colorado River, the bed-load problem in general, and bed-load characteristics are discussed. Compares the estimated rate of silting of Elephant Butte Reservoir on the Rio Grande as determined from suspended-load measurements (W. W. Follett) with actual observed rates (U. S. Bureau of Reclamation) and suggests that the difference of 8,200 or 40 percent of true value represents the bed load carried into the reservoir. THE AUTHOR, pp. 1150-1151, mentions volume-weight determinations of Colorado River silt, bed-load movement, sampling, and estimates of total bed load. Notes conditions of bed-load movement in the Sacramento River, near Princeton, Calif.

6. Some aspects of the flood-control problem. *Military Engin.*, vol. 24, no. 136, pp. 336-343, July-Aug. 1932.

Discusses the formation of alluvial valleys, the overtopping of river banks in flood stage, the formation of flood basins, the effect of confining a river to its channel on flood discharge, the formation of deltas at river mouths, the character of river bed in relation to distance up stream, the effect of river shortening on water level, sediment load and readjustment of bed, the effect of temporary storage on shape of flood wave and maximum stream flow, and analysis of formulae for maximum rainfall and maximum stream flow.

GUÉRARD, ADOLPHE.

1. Mouth of the River Rhone. *Inst. Civ. Engin.*, Minutes of Proc., vol. 82, pp. 305-336, illus., 1884-85.

Discusses the regimen of the Rhone River and gives data on alluvium carried by it, including data on channel silting. Comments on the formation of the Rhone Bar. Effects of variations in density on rates of settling are noted. Bed-load movement and sorting at river mouths are discussed.

GUISE, C. H. See Gustafson, A. F., 2.

GULATI, THAKAR DASS. See Uppal, H. L., 2.

GULLING, P.

1. To keep California's desert blooming. *Dravo*, vol. 1, no. 3, p. 8, illus., 1939.

Briefly describes the Imperial Diversion Dam and the All-American Canal into which is fed desilted water from the Colorado River. Includes an illustration of the Imperial Diversion Dam showing the roller gate section which feeds water into the canal through six desilting basins, removing daily most of 60,000 tons of silt contained by the water treated.

GULLIVER, F. P.

1. *Marais de Saint Gond*. Science, vol. 5, no. 121, p. 646, Apr. 23, 1897.

Describes conditions of aggradation of the Petit Morin (France) and the creation of a broad marsh, the Marais de Saint Gond.

GUPPY, H. B.

1. The rivers of China. *Van Nostrand's Engin. Mag.*, vol. 24, no. 1, pp. 63-67, tables, Jan. 1881.

Gives data on discharge and sediment-load data of the Yang-Tse, Yellow and Pei-Ho Rivers. Gives a table comparing the discharge of water, sediment load per annum, and subaerial denudation of the major rivers of the world.

GUSTAFSON, A. F.

1. Dumping soil into the sea. *Farm and Fireside*, vol. 38, no. 18, pp. 5-7, illus., June 15, 1915.

Notes that Middle West farms lose 11 tons of earth a second through soil working and recommends various control measures for the catching and holding of soil run-off. A fill 60 ft. wide and 2 ft. thick at the deepest point was made in a hollow in St. Clair County, Ill., in 3 years' time from soil carried by a small stream; the Prairie du Pont Creek filled nearly 700 acres of a lake near East St. Louis, Ill.; the cutting of a levee holding a creek in Pike County, Ill., resulted in a deposit on a farm of 4-6 ft. of fine sandy silt loam.

2. (and others). *Conservation in the United States*. 445 pp., illus. Ithaca, N. Y., Comstock Pub. Co., 1939.

H. Ries, C. H. Guise, and W. J. Hamilton, Jr., joint authors.

Discusses conservation in all its phases, and includes discussions on effects of erosion by water; loss of fine soil material, its transportation by streams, and its deposition in streams and valleys; beneficial and destructive effects of deposits of eroded material; and effects of wave erosion. The filling of reservoirs with silt and sand is discussed, noting factors influencing the silting of reservoirs, economic losses due to reservoir silting, comparative life spans of reservoirs in cultivated and mountainous watersheds, and influence of forests on reservoir silting. A table of location and rate of silting of various reservoirs in the United States is given. Discusses problems of reservoir silting and methods of prevention and control.

GUTH, EUGENE.

1. On the hydrodynamical theory of the viscosity of suspensions. *Internatl. Cong. Appl. Mech.*, Proc. (1938) 5, pp. 448-455, illus., 1939.

The theory originated in Einstein's paper entitled "On a New Determination of the Dimensions of Molecules" (1906) which is a generalization of the Stokes' problem and the results of which have application to the viscosity of suspensions dependent upon size and shape of suspended particles. Discusses investigations of Einstein's theory relative to suspension of spherical particles and its extension by Jeffries to ellipsoidal particles; limits of validity of hydrodynamical treatment; general theorems and equations of viscosity of suspensions; theories and equations for viscosity of spherical and ellipsoidal suspensions, wall and concentration (interaction), and inertia effects. Outlines briefly a generalization of the hydrodynamical theory of viscosity of suspensions relative to the effect of the Brownian movement on suspensions, the development of Einstein's theory for a Poiseuille primary flow, the effect of electrokinetic double layer in increasing viscosity of a suspension, and the extension by Taylor of Einstein's theory to emulsions. Application of the theoretical hydrodynamical viewpoint to viscosity of colloidal solutions is noted.

GUTHRIE, F. B. See David, T. W. E., 1.

HAAS, WILLIAM H.

1. Formation of clay balls. *Jour. Geol.*, vol. 35, no. 2, pp. 150-157, illus., Feb./Mar. 1927.

Discusses the various conditions under which the action of water produces spherical masses of clay. The chief factors in their production are considered, and the formation of clay balls in arroyo development is described.

2. The problem of the Mississippi. *Ill. Acad. Sci., Trans.*, vol. 21, pp. 257-261, 1928.
Discusses the effect of velocity, volume, friction, obstacles, and load carried on gradient of streams, aggradation and degradation of stream bed; and variations in gradients of streams. States that the bed of the Mississippi River is silting up, gives proof, and notes need for proper river control.
 3. The present status of the Mississippi problem. *Ill. Acad. Sci., Trans.*, vol. 24, no. 2, pp. 393-400, Dec. 1931.
Discusses the problem of regulating the Mississippi River. Describes the purpose and use of levees to maintain navigable channels and to prevent floods. Gives a plan of river control, noting the use of spillways. Notes need for further bank protection, prevention of cut-offs at bends, and development of the stream course into a more efficient silt-bearer. States that revetment will reduce the amount of silt in the river from 1/3 to 1/5 and elimination of present bends will double the gradient and increase efficiency.
- HAEGELEN, A. See Simon, P., 1.
- HAGERMAN, TOR H.
1. Some lithological methods for determination of stratigraphic horizons. *World Petrol. Cong.*, London, 1933, *Proc.*, vol. 1, pp. 257-259, 1934.
Utilizes grain shape to mark different stratigraphic horizons. Presents a method for the measurement of geometrical properties of quartz grains. The shape of the distribution field obtained is related to conditions of sedimentation, such as turbulence and current velocity, which is characteristic of certain stratigraphic horizons.
 2. Granulometric studies in northern Argentine (with a short chapter on the regional geology of central South America). *Geog. Ann.*, vol. 18, 212 pp., illus., 1936.
Reviews the regional geology of central South America. Gives methodology and results of granulometric work. Gives various formulas used in determining silting of particles. Comments on Gilbert's experiments at Berkeley. Devises and employs methods for the characterization of mechanical sedimentary material containing quartz, based on statistical measurements of the dimensions of the grains deposited together. Discusses the transportation and deposition of sediments. The writer gives techniques used in the determining of grading type, grain-size variations, qualitative and quantitative of relative widths.
- HAIG, H'DE H.
1. Forests and fertility. *Discovery*, vol. 4, no. 41, pp. 129-132, May 1923; [abstract], *Sci. Amer.*, vol. 129, no. 11, p. 329, Nov. 1923.
Reports the effects of denudation on soil fertility, filling up and choking of river beds, and floods. Cites example of these effects at port of Pisa during the fourteenth and fifteenth centuries.
- HAIGH, F. F.
1. Silt excluders. *Punjab Engin. Cong. Minutes of Proc.*, vol. 26, pp. 53-72, illus., 1938.
Description and discussion of the design and efficiency of various silt excluders used on various canals in India.
- HALL, C. H. See Haslam, G. S., 1.
- HALL, C. L. See Churchill, M. A., 4; Fry, A. S., 2; Matthes, G. H., 6.
- HALL, JOSEPH W. See Laverty, F. B., 1.
- HALL, L. STANDISH. See also Dobbins, W. E., 1; Stevens, J. C., 6; Witzig, B. J., 1.
1. Silting of reservoirs. *Amer. Water Works Assoc. Jour.*, vol. 32, no. 1, pp. 25-42, Jan. 1940.
Describes results of silt measurements in reservoirs of the East Bay Municipal Utility District, Calif., with a comparison of rates of silting in other reservoirs. Outlines proposed methods of erosion control on watershed lands above reservoirs. Describes area and topography of local watersheds, soil types, rainfall, land use, and areas of erosion; Mokelumne River watershed and Pardee Reservoir; methods of measuring silt deposits in District reservoirs; and silt sampling equipment. Surveys of Lake Chabot indicate a total loss in capacity of 3,307 acre-feet due to silt deposits during an interval of 48 yr., a mean annual deposit of 68.9 acre-feet. The survey of 1935 on upper San Leandro Reservoir shows that total sedimentation during 11 yr. amounted to 170 acre-feet, or 0.4 percent of the original capacity. Computations of cross-sections taken on a survey in 1939 of San Pablo Reservoir show total deposits of 1,133 acre-feet of silt in 21 yr. or 2.6 percent of the original capacity. Tabulated data comparing silting in District reservoirs with that measured in other reservoirs are given, noting in particular variations in rate of silting for various reservoirs. Silting in Lake Chabot indicates that the rate varies between different periods. Discusses rates of erosion of the District's watersheds; effect of vegetation in controlling erosion, noting results obtained at McMillan Reservoir, Pecos River, N. Mex. with the growth of tamarisk; effect of denudation on rate of erosion (Gibraltar Reservoir, Santa Ynez River); and character of soils affecting erosional rates (La Grange Reservoir, Black Canyon Dam, and Roger Municipal Reservoir). Notes method of discharging turbid bottom flow through sluice valves in the bottom of Pardee Reservoir. Data on life span of District reservoirs, including the proposed Pinole Reservoir, are given. Methods of controlling erosion by employing engineering and forestry practices are discussed.
 2. Drop structures for erosion control. *Civ. Engin.*, vol. 12, no. 5, pp. 247-250, illus., May 1942.
Discusses structures built in the watersheds above water-supply reservoirs of the East Bay Municipal Utility District, Calif., to control erosion and reduce sedimentation in reservoirs.
- HALL, LEONARD.
1. Deterioration of rivers in the Ozarks. *Mo. Wildlife*, vol. 9, no. 1, p. 10, Jan. 1947.
Points out that the destruction of forests and poor farming practices have caused the streams in Missouri to silt up and thus the subsequent loss of fishing streams. Advocates a forestry law so that private land-owners can undertake reforestation.
- HALL, ROBERT G. See Mitchell, R. H., 1.
- HALL, WILLIAM HAM.
1. Effects of the flow of mining debris. *Calif. State Engin. Rpt.*, pt. 3, pp. 8-43, 1880.
Deals with effects of the flow of mining debris as they pertain to the rivers of the Sacramento, Yuba, Feather, Bear, and American river valleys and on agricultural and municipal lands adjacent to these rivers and their tributaries. Considers in this connection, the extent of filling in river channels and its effects on the carrying capacity of streams, on floods, and on flood damage. Presents and discusses results of observations on volumes and weights of sediments in California and foreign rivers, on the amount of material transported by the river waters, and on the extent of proposed storage of mining debris behind dams.
 2. Memorandum concerning the improvement of the Sacramento River. *Calif. State Engin. Rpt.*, pt. 2/3, pp. 15-23, 1881.
Comments on various improvements in the Sacramento River. Treats of the removal of channel bars, alignment of banks, straightening of the river, and flood-escape weirs.
- HALL, WILLIAM M.
1. Some notes on the location and construction of locks and moveable dams on the Ohio River, with particular reference to Ohio River Dam No. 18. *Amer. Soc. Civ. Engin., Trans.*, vol. 86, pp. 92-131, illus., 1923.
Discusses the factors influencing location, design, and construction of the Ohio River Dam No. 18, and gives a brief historical description of improvements to navigation on the Ohio River; examines the utility of moveable locks and dams to maintain navigable depths. Notes that choice of site below Vienna Island is preferable since no danger exists, at that point, of "sanding up" the wickets and pass sill. Condi-

tions and effect of silt deposits in 15 ft. bear traps in Dam No. 18 are noted. The method of cleaning is described.

Discussion: EARL I. BROWN, pp. 137-139, notes effect of dams, below Dam No. 31 on the Ohio River, on conditions of bed and bank erosion during freshets and effect of quantity of sediment carried in the middle and lower sections of the River on construction work. Proposes use of mitering gates in dams in lower portion of River to avoid difficulties encountered due to mud and sand accumulations in roller gate recesses. WILLIAM W. HARTS, pp. 139-142, includes one paragraph stating that objection to the use of fixed dams on the Ohio, is that they would obstruct navigation and possibly cause channel to fill with sand and mud, thus affecting navigable depths, necessitating the construction of moveable dams. C. I. GRIMM, pp. 147-151, includes two paragraphs in which writer compares the use of both rolling and mitering gates in moveable dams on the Ohio River, noting, with reference to the former, conditions of mud and sand deposits which fill recesses during high water and sand deposits which fill recesses during high water and which affect the operation of the dam. THE AUTHOR, pp. 172-179, comments on discussion by Col. Brown with reference to the effect of quantities of shifting sand on operation costs of moveable dams in the lower Ohio River, the effect of accumulations of deposits on gate maneuvers, and the location of recesses to avoid silt accumulations. Notes extent of deposits in recesses of Lock 18 after winters, 1910-13.

HALLER, H. S. See Collins, W. D., 6.
HALLIER BROS.

1. A new method of silt control. *Farmer's Weekly* [Bloemfontein], vol. 55, p. 201, Mar. 30, 1938. Suggests a method of preventing the silting of conservation dams in Karoo or "silty areas," by building a dam as far upstream as possible and desilting the entire flood water from the drainage basin before releasing it. Authors give general information on type of outlet which can be used efficiently as the reservoir becomes silted. As reservoirs silt up dams are raised and valuable "vlei" is created above.

HAMILTON, W. J., JR. See Gustafson, A. F., 2.
HAMMETT, W. C.

1. Protection of river banks with spur dikes [letter to editor]. *Engin. News-Rec.*, vol. 87, no. 9, p. 376, illus., Sept. 1, 1921. Describes a method of bank protection on torrential streams using spur dikes to stop erosion and promote deposition of suspended material. Notes use of mattresses on the Sacramento River to retard velocities and afford bank protection.

HANCOCK, R. T.

1. Transportation of debris by running water [letter to editor]. *Engin. and Mining Jour.*, vol. 99, no. 10, pp. 459-460, Mar. 6, 1915. Comments on Transportation of Debris by Running Water (Gilbert, G. K., 11). Notes that Gilbert's experimental data on relation of capacity to slope is applicable only to low grades. Discusses capacity of channel as a function of depth and width, noting that capacity increases with increased quantities of water up to the point of saturation after which capacity commences to fall off. Considers the effect of constant slope and water supply with varying trough widths, noting that maximum capacity and duty consist in proportioning the width of the trough to the available water supply and not to depth, velocity or form-ratio. Requests data on trough widths for the narrow range of slopes used for average gravel in hydraulic mining.

HANDBURY, T. H.

1. Regulation of shifting river channels. *Sci. Amer.*, vol. 42, no. 11, p. 160, Mar. 13, 1880. Describes means of regulating the shifting channel of the Missouri River. Discusses briefly conditions of bank erosion and the transportation and deposition of sediment in the Missouri River. Describes methods of channel regulation by use of floating brush dikes, willow

curtains, and wire screens to induce deposits and deflect current, and methods of bank protection by woven brush revetment, continuous mats, brush blankets, and willow curtains.

HANSEN, ORVILLE C.

1. (and Steps, W. E., and Gottschalk, L. C.). Sedimentation survey of Leavenworth County State Lake, Tonganoxie, Kansas. 22 pp., illus. Lincoln, Nebr., U. S. Soil Conserv. Serv., Water Conserv. Div., 1949.

A report which contains the results of a detailed sedimentation survey of Leavenworth County State Lake near Tonganoxie, Kans. This survey was made during October and November 1947, by the Division of Water Resources, Kansas State Board of Agriculture, and the U. S. Soil Conservation Service to determine the useful life expectancy of the lake; to determine the relation of sedimentation to physical features and land use; and to provide data useful in developing regional sediment-production indices which could be used to estimate sediment damages to existing and proposed reservoirs and for developing methods to control sedimentation. Includes data on mechanical analyses of sediment samples. Contains a table which gives a summary of data on reservoir sedimentation surveys in Kansas.

HANSLOW, H.

1. Soil erosion. *Austral. Munic. Jour.*, vol. 19, no. 422, pp. 207-210, Oct. 16, 1939.

Describes conditions and effects of culturally accelerated soil in Australia, conditions of stream and valley sedimentation, and the silting up of reservoirs as a consequence of accelerated erosion. Economic aspects are considered. Experience in other lands relative to the effects of erosion is briefly discussed.

HANSON, GEORGE.

1. Varved clays of Tide Lake, British Columbia. *Roy. Soc. Canada, Proc. and Trans.*, vol. 26, sect. 4, pp. 335-339, illus., May 1932.

Describes varved clay formations of the Tide Lake, British Columbia. Discusses the formation of the lake by a glacial moraine. Disappearance of the lake in 1930 was due to the retreat of the glacier and to the cutting of a channel through the moraine. Its reappearance in 1931 was due to rapid melting of the ice. Discusses composition of the laminated sediment in the basin of the lake, and the action of clay in water. Describes the manner in which sediments were washed into the basin of the lake, and the method of obtaining estimates of the thickness of lake sediments.

2. The Bear River Delta, British Columbia, and its significance regarding Pleistocene and Recent glaciation. *Roy. Soc. Canada, Proc. and Trans.*, vol. 28, sect. 4, pp. 179-185, May 1934.

Describes Bear River and discusses the rate of advance of the delta, noting an average annual rate of 30 ft. Material totaling 2.25×10^7 cu. ft. is added each year. From the total amount of delta material it is calculated that the time required for the formation of the delta should be less than 3600 yr. Material of the Bear River delta is deposited almost entirely by glacial streams. Discusses the origin of the glaciers of the district.

HÄNTZSCHEL, WALTER.

1. Tidal flat deposits (Wattenschlick). In Trask, P. D., ed. *Recent marine sediments; a symposium*, pp. 195-206, illus. London, T. Murby and Co., 1939.

Describes origin, conditions of formation, and characteristics of tidal slime or mud (Wattenschlick) deposits at the mouths of large rivers along the North Sea coast, Germany. Tidal mud deposits consist of a large amount of fine silt and clay and of a small amount of sand, and are stratified in fine laminae. They are largely derived from suspended matter carried into sea by streams, the sediment being deposited where currents are weakest. Notes that in some places near Cuxhaven, at the mouth of the Elbe River, sediment deposits of 3 meters were observed in a year. Deposits add arable land to the coast of Germany, increase fertility of soil, and serve as a therapeutic agent (mud baths).

HAPP, STAFFORD C. See also Broughton, W. A., 1; Jones, V. H., 11; MacClintock, P., 1; Stevens, J. C., 6; Witzig, B. J., 1.

1. Fertile valleys laid waste by upland erosion. *Soil Conserv.*, vol. 2, no. 9, pp. 194-198, illus., Mar. 1937.

Discusses causes and effects of deposition of sediment in streams and valleys, particularly studies of the Section of Sedimentation Studies, Division of Research, U. S. Soil Conservation Service, in Wells drainage district, Lafayette County, Miss. The need for drainage in Wells district is due mainly to the clogging of stream channels by sand washed from gullies in tributary uplands. Describes the condition in Wells district, noting watershed features causing sanding, development of system of arroyos trenching headwater parts of the valley, and bank erosion as a result of stream bed filling. Notes need for consideration and control of upland erosion in attempting control of drainage and sedimentation problems.

2. (and Rittenhouse, Gordon, and Dobson, G. C.). Classification of valley sedimentary deposits [extract]. *U. S. Soil Conserv. Serv. Sedimentation Div.*, Tech. Let. Sed-5, 10 pp., Feb. 21, 1939.

An extract from *Some Principles of Accelerated Stream and Valley Sedimentation* (Happ, S. C., 9). Classifies the modern sediments of valley sedimentary deposits into various types; considers modern sediments in Tobittubby and Hurricane Valleys. Gives a table of the characteristics of genetic types of valley deposits.

3. (and Rittenhouse, Gordon, and Dobson, G. C.). Increased terrace flooding due to flood-plain aggradation, as illustrated in Tobittubby Valley, Lafayette County, Mississippi [extract]. *U. S. Soil Conserv. Serv.*, Sedimentation Div., Tech. Let. Sed-7, 4 pp., Feb. 21, 1939.

An extract from *Some Principles of Accelerated Stream and Valley Sedimentation* (Happ, S. C., 9). Discusses the effect of sedimentation in aggravating flood danger and causing increased terrace flooding due to flood-plain aggradation as shown in Tobittubby Valley, Lafayette County, Miss.

4. Instructions for stream and valley sediment surveys. *U. S. Soil Conserv. Serv.*, Sedimentation Div., Tech. Let. Sed-3, 41 pp., Feb. 21, 1939. Considers such items as purpose, plan of investigations, reconnaissance, detailed field surveys, laboratory investigations, office work, note keeping, public relations, preparation of reports, and outline of reports.

5. (and Rittenhouse, Gordon, and Dobson, G. C.). Some factors in the relation of stream and valley sedimentation to flood-control problems [extract]. *U. S. Soil Conserv. Serv.*, Sedimentation Div., Tech. Let. Sed-6, 9 pp., Feb. 21, 1939.

An extract from *Some Principles of Accelerated Stream and Valley Sedimentation* (Happ, S. C., 9). Discusses various factors in relationship of stream and valley sedimentation to flood-control problems.

6. (and Rittenhouse, Gordon, and Dobson, G. C.). Some principles of accelerated stream and valley sedimentation [extract]. *U. S. Soil Conserv. Serv.*, Sedimentation Div., Tech. Let. Sed-4, 5 pp., Feb. 21, 1939.

An extract from *Some Principles of Accelerated Stream and Valley Sedimentation* (Happ, S. C., 9) which gives various principles of accelerated stream and valley sedimentation.

7. [Review of] *Geology of Grant and La Salle Parishes*, by H. N. Fisk. *Jour. Geomorph.*, vol. 2, no. 2, pp. 164-166, Mar. 1939.

Reviews an article on the geology of Grant and La Salle Parishes (Fisk, H. N., 1). Notes that nearly half is devoted to Pleistocene and Recent sediments. Treats of meandering-terrace and flood-plain deposits, development of natural levees, etc.

8. Stream and valley erosion and deposition. 5 pp. *Internatl. Geod. and Geophys. Union Round-Table Discuss.*, Washington, Sept. 13, 1939.

Report for the round-table discussion on 'The Role of Hydraulic Laboratories in Geophysical Research, at the National Bureau of Standards, Sept. 13, 1939, relative to a limited program of

field research on stream and valley erosion and deposition. An attempt is made to set up a new genetic classification of valley sediments. Discusses the objectives and methods of study for the program.

9. (and Rittenhouse, Gordon, and Dobson, G. C.). Some principles of accelerated stream and valley sedimentation. *U. S. Dept. Agr., Tech. Bul.* 695, 133 pp., illus., May 1940.

Presents some results of a study of the principles of stream and valley sedimentation under the influence of culturally accelerated soil erosion, based chiefly upon results of detailed studies of sedimentation by the U. S. Soil Conservation Service during the winters of 1935-36 and 1936-37 on the drainage basins of Tobittubby and Hurricane Creeks in Lafayette County, Miss. Describes conditions in these valleys and their tributary drainage areas; location of the valleys; sediment production; methods of investigation of valley sedimentation; types of deposits; amount, distribution, and character of modern valley deposits; damages directly due to excessive sedimentation; local control and reclamation efforts; relation to downstream flood problems; and extent of erosion in the drainage areas as measured by valley sedimentation. Outlines and discusses the controlling physical principles that govern excessive stream and valley sedimentation as developed by analysis of the results of the Tobittubby-Hurricane investigation and less detailed studies in the United States.

10. Formula for approximate valley sediment-volume computations. *U. S. Soil Conserv. Serv.*, Sedimentation Div., Tech. Let. Sed-14, 2 pp., Oct. 21, 1940.

Presents a formula for use in computing volumes of valley sedimentary deposits where the original data are less than exact and less detailed than required for careful volume computation by the Dobson volume formula as given in Tech. Let. Sed-3 (Happ, S. C., 4).

11. Sedimentation in artificial lakes. In *A Symposium on Hydrobiology*, pp. 35-44. Madison, Wis., Univ. Wis. Press, 1941.

A discussion of the distribution of reservoir sedimentation measurements made in the United States by the U. S. Soil Conservation Service and other agencies and the average sedimentation rates from these surveys for several regions. Includes a discussion of various factors related to reservoir silting. In conclusion the author points out that artificial lakes are being silted much more rapidly than older natural lakes; that detailed surveys show that sedimentation usually affects the entire area of the lake and may be much more rapid and extensive than indicated around the margins or on deltas; and that continually submerged sediment remains soft and uncompacted for at least a number of years.

12. Flotation of peaty alluvial soils. *Amer. Jour. Sci.*, vol. 241, no. 10, pp. 629-639, illus., Oct. 1943.

Peaty soil "boulders" are common along many small streams of the Driftless Area and contiguous parts of Minnesota and Wisconsin. Most are obviously derived from old, dark, peaty alluvial soil horizons exposed in the stream banks. In several instances these peaty "boulders" have been observed to float, and there is at least one eye-witness account of extensive "flotation erosion" of peaty alluvium in 1866. Recent studies suggest that flotation of peaty alluvial soils may have been much more common in the early years of white settlement. This inference provides a logical explanation for several otherwise puzzling anomalies in the nature of the alluvial deposits. Similar processes may have been important also in the selective removal of organic material from the upland topsoils during the early years of white settlement.

13. Effect of sedimentation on floods in the Kickapoo Valley, Wisconsin. *Jour. Geol.*, vol. 52, no. 1, pp. 53-68, illus., Jan. 1944.

Deals with the effect of sedimentation on floods in the Kickapoo Valley in the rugged Driftless Area in Wisconsin. Fluvial sedimentation has been accelerated in the area due to deforesta-

- tion, cultivation, and grazing of the sloping ridge crests and valley sides. Points out that black first-bottom soils are nearly all covered by stratified brownish "modern" sandy silt since 1850. Notes that the rate of river-channel aggradation is about 1 ft. in 20 yr. Aggradation of the river channel and flood plain is causing more frequent, deeper, and more extensive flooding of low alluvial terraces which are the sites of the towns; damages to highways, agricultural lands, and crops will be increased.
14. Significance of texture and density of alluvial deposits in the middle Rio Grande Valley. Jour. Sedimentary Petrology, vol. 14, no. 1, pp. 3-19, illus., Apr. 1944.
Discusses the results of mechanical analyses of representative samples of alluvial deposits in the Middle Rio Grande Valley. Points out that the results lend support to the use of sand sizes as criteria of the sources of all sediment in the valley; textural data also indicate that sand accumulation along the Rio Grande is due to excessive supply from tributary sources rather than lag accumulation. Shows that "splay" deposits and channel avulsions on the flood plain are major factors in river regime, and notes that the extension of the textural studies might provide a useful measure of the relative importance of different erosional processes. Density determinations in combination with other data provide a basis for estimating the entire rate of sediment output, or net erosion, from the drainage basin above Elephant Butte Reservoir; this rate is indicated as 0.7 acre-foot per square mile for the period 1936-41 or equivalent to an average rate of surface lowering of 1 in. in about 75 yr.
 15. Sedimentation in South Carolina Piedmont Valleys. Amer. Jour. Sci., vol. 243, no. 3, pp. 113-126, Mar. 1945.
Discussion of modern sediment laid down in the last 150 yr. over dark topsoil horizon representing more stable alluvium prior to white settlement. Average thickness of modern sediment is about 4 ft., equivalent to removal of about 3.1 in. from the tributary uplands. Erosion surveys by U. S. Soil Conservation Service indicate about twice this amount of soil loss. Valley sedimentation causes the major part of frequent flood damage on about 80,000 acres of corn land and 40,000 acres of cleared pasture. Soil conservation practices may reduce valley sedimentation rates somewhat, but any major improvement will require more direct reclamation measures.
 16. Arroyo problem [abstract]. Geol. Soc. Amer. Bul., vol. 57, no. 12, pt. 2, p. 1199, Dec. 1946.
Abstract of paper presented at the Chicago Ill., meeting Dec. 26-28, 1946. Channels of intermittent streams are being deepened and widened throughout large parts of the United States. Recognized in the Southwest as the "arroyo problem" this has been attributed to climatic change and depletion of vegetation by overgrazing. The similarity in conditions in formation of channels in other sections of the country as well as the Southwest calls for a similar explanation of causes, either climatic changes or depletion of vegetative cover. The latter appears to be the more reasonable explanation.
 17. Alluviation of the Whitewater Valley, Minnesota [abstract]. Geol. Soc. Amer., Bul., vol. 58, no. 12, p. 1187, Dec. 1947.
Soil erosion since white settlement in the watershed of the Whitewater River, Minn., has caused a new cycle of alluviation. Sediment deposited in the main valley has buried the former flood plain to average depths ranging from 1.3 ft. to 5.7 ft. on representative cross-section lines resulting in raising of flood-stage heights and ground-water levels. New deposits aggregate about 13,000 acre-feet, an amount equal to about 1 in. of erosion from the drainage area of 320 sq. miles.
 18. Sedimentation in the Middle Rio Grande Valley, New Mexico. Geol. Soc. Amer., Bul., vol. 59, no. 12, pp. 1191-1216, illus., Dec. 1948; [abstract], Geol. Soc. Amer. Bul., vol. 57, no. 12, pt. 2, p. 1200, Dec. 1946.
Describes the sedimentation problem in the Middle Rio Grande Valley. The sediment accumulation shown by surveys amounts to a rate of 12,000 acre-feet per year or 22,500,000 tons 1936-41. Discusses factors causing the sediment accumulation. Sedimentation problems in the conservancy district floodway and the Elephant Butte Reservoir are considered. Comments on the seriousness of sedimentation and river aggradation in the development of the region. Increase in sedimentation since 1870 is believed to be a result of arroyo erosion. Possible remedial measures are suggested.
- HARBAUGH, ROBERT. See Young, C. H., 1.
HARDEE, W. J. See Brown, L. W., 1.
HARDIN, GEORGE C., JR.
1. [Review of] Gully gravure - A method of slope retreat, by Kirk Bryan. Jour. Sedimentary Petrology, vol. 11, no. 3, pp. 149-150, Dec. 1941.
Reviews the paper (Bryan, K., 14). Notes that the term "gully gravure" is introduced to designate the recurrent cycle of processes by which steep slopes of hills and mountains retreat. Notes that Kirk Bryan fails to consider the effect of the cycle and the formation of an impervious layer upon the vegetative cover which has an effect on the sediments derived from a region.
- HARDING, H. M.
1. Subsidence of river banks. Military Engin., vol. 13, no. 72, pp. 478-479, Nov./Dec. 1921; [abstract], Engin. and Contract., vol. 56, no. 24, p. 558, Dec. 14, 1921.
Discusses a state of bank subsidence due to underground flow and incorrect drainage of banks, and other instances of subsidence where river erosion had not been the cause. The writer recommends a general outline of corrective measures.
- HARDY, E. D.
1. Water purification plant, Washington, D. C. Results of operation. Amer. Soc. Civ. Engin., Trans., vol. 72, pp. 201-361, illus., 1911.
Outlines the operation of water purification plant on the Potomac River at Washington, D. C. Includes nine paragraphs noting turbidity conditions in the Potomac River; means of clarification of the water supply and effect of reduction in turbidity at the plant on deposition of sediment in the Dalecarlia Reservoir; deposition of mud in Dalecarlia, Georgetown and McMillan Park Reservoirs; and dredging at Dalecarlia Reservoir. Total suspended matter (July 1909-June 1910) in the stream amounted to 6,522 tons while the amount excluded from the system by gates at Great Falls amounted to 2,613 tons. Deposits in the Dalecarlia Reservoir were 2,122 tons; in McMillan Park Reservoir, 611 tons; and in Georgetown Reservoir, 515 tons.
- HARE, R. F. See Meinzer, O. E., 3.
HARGROVE, B. D. See Lutz, J. F., 1.
HARISBERGER, JOHN.
1. Solids a problem at power plants in the Northwest. Engin. Rec., vol. 74, no. 10, pp. 290-291, illus., Sept. 2, 1916.
Considers the solid matter carried by streams which originate in glaciers in the Cascade and Olympic Mountains. Rock spillways in the supply channel take care of the gravel. Notes also the use of settling basins for removal of sand. These methods are needed for silt removal in the design of waterways and reservoirs.
- HARLAND, M. B. See Winters, E., Jr., 1.
HARLEMAN, DONALD ROBERT F.
1. Characteristics of density currents, 53 pp., illus. May 23, 1947. Unpublished thesis (M. S.) - Massachusetts Institute of Technology.
A thesis which provides a mathematical treatment of the mixing characteristics of density currents. The problem was to determine the conditions under which a density current will flow, without turbulent mixing at the interface of two liquids, through a still body of another liquid which has a slightly different density. Presents the basic theory of the motion of superimposed fluids of different densities. Develops an analytical formula for the determination of the critical velocity of a density current. Reviews previous investigations. Gives various conclusions.

HARMAN, JACOB A.

1. Methods for and results of protection and drainage of overflowed land in southwestern Iowa. Iowa State Drain. Assoc., Proc. 8, pp. 48-53, 1912.
Describes methods for the protection of overflowed land and for the prevention filling of ditches in southwestern Iowa where small sediment-laden streams from the hills discharge upon lowlands, deposit sediment near the foot of the hills, and spread out over bottom lands.
2. Report and plans for reclamation of lands subject to overflow in the Embarrass River Valley, Ill. State Geol. Survey, Bul. 25, 61 pp., illus., 1913.
Gives a general description of the valley. Considers the problem and gives the plans for the reclamation of land. Costs are estimated and recommendations given.
3. Report and plans for reclamation of lands subject to overflow in the Spoon River Valley, Ill. State Geol. Survey, Bul. 32, 57 pp., illus., 1916.
Describes plan for the alleviation of the flood problem and for the reclamation of lands subject to overflow in the Spoon River Valley, Ill. Notes provisions for sedimentation areas to reduce the ditch maintenance problem in the region.

HARPER, HORACE J.

1. (and Murphy, Henry F.). A study of the amount of sediment carried by runoff water. Okla. Acad. Sci., Proc., vol. 10, pp. 114-117, 1930.
Consists of results of a study to determine the amount of sediment carried in runoff water in several streams at flood stage and from terraced and unterraced soil in Oklahoma. Streams studied included Stillwater Creek, Black Bear Creek, Cimarron River and Cow Creek. Suspended load of these streams is less than 1 percent when rate of flow is 3 ft. per sec. or less. Comparison is made with the suspended load of the Colorado River, the Rio Grande, the North Fork of the Red River and the Salt Fork of the Red River. Water from cultivated fields showed larger quantities of sediment, and water from terrace outlets showed smaller quantities than that in streams at flood stage. It is estimated that 90 percent of the sediment carried into Boomer Reservoir at Stillwater, Okla., is deposited.
2. (and Hollopeter, Charles A.). Buried soils and their significance. Okla. Acad. Sci. Proc., vol. 12, pp. 63-66, 1932.
Presents results of a study of agencies which are important in the formation of buried soils. The formation of buried soils in Oklahoma is caused by the deposition of sediments by action of wind and running water. The activity of streams in connection with the formation of buried soils is discussed; an example being a buried soil formed from the weathering of sandy shale on the west bank of the Salt Fork River at Pond Creek, Okla. Considers buried soils in relation to the movement of sand dunes but states that no evidence of buried soils was discovered at the edge of the sandy areas on the north side of the Cimarron and Salt Fork Rivers.
3. Further investigations of buried soils in relation to climatic changes in Oklahoma. Okla. Acad. Sci. Proc., vol. 14, pp. 55-57, illus., 1934.
Shows relationship between factors causing the formation of buried soils in Oklahoma and the correlation of buried-soil occurrences in Oklahoma with climatic conditions affecting loess formation in the central portion of the United States.
4. Effect of silting on tree development in the flood plain of the North Canadian River in Creek County, Okla. Acad. Sci. Proc., vol. 18, pp. 46-49, illus., 1938.
Considers the effects of silt deposits on the development of trees in the flood plain of the Deep Fork of the North Canadian River in Creek County, Okla. Describes silt damage to trees on the flood plain and notes growth of young trees on recent deposits of silt and clay.
5. Measurement of sediment in Boomer Creek Reservoir, Payne County, Oklahoma. Okla. Acad. Sci. Proc., vol. 21, pp. 111-116, illus., 1941.
Deals with a study of sediment in Boomer

Creek Reservoir which is located 1 1/2 miles north of Stillwater, Okla. Notes that the average annual rate of sedimentation for the 15 yr. period, 1925-39, has been 0.14 percent. The low rate of silting is due to a protective cover on the watershed. The total capacity of the reservoir was 2,479 acre-feet when constructed and it had a surface area of 253 acres. The amount of mud which had accumulated during the 15 yr. period was 51.65 acre-feet which is considerably less than calculations made by a survey party in 1935.

6. (and Rose, Lonnie E.). Effect of silt on natural vegetation and drainage in the flood plain of Deep Fork of the North Canadian River, Lincoln County, Oklahoma. Okla. Acad. Sci. Proc., vol. 24, pp. 80-82, 1944.
Describes effects of silt on natural vegetation and drainage on the Deep Fork flood plain in Lincoln County, Okla.
7. Improvement of flood-damaged land in eastern Oklahoma. Okla. Agr. Expt. Sta. Bul. 282, 28 pp., illus., Oct. 1944.
Discusses flood damage in May 1943 to productive land in the Arkansas River Valley. Soil erosion and deposits of silt have affected the productivity of the land. Describes soil treatment needed to improve crop-producing capacity of land covered with alluvium. Suggests crops adapted for present surfaces. Indicates how to reduce future flood damage by cropping systems.

HARRINGTON, H. H.

1. A preliminary report on the soils and waters of the upper Rio Grande and Pecos Valleys in Texas. Tex. Geol. Survey, Bul. 2, 26 pp., 1890.
A report on the soils and waters of the upper Rio Grande and Pecos Valleys, Tex., with particular reference to irrigation possibilities. Gives brief data on the chemical composition of the Rio Grande River sediment taken from irrigation ditches (San Elizario Station) and the quality of Rio Grande and Pecos River waters.

HARRIS, A. L.

1. The diversion of irrigating water from Arizona streams. Amer. Soc. Civ. Engin., Trans., vol. 77, pp. 932-951, illus., Dec. 1914; [abstract], Engin. and Contract., vol. 42, no. 8, pp. 184-185, illus., Aug. 19, 1914.
Deals with the principal features and conditions relative to writer's experience in designing works for the diversion of irrigating water from Arizona streams. Describes the regime of a typical Arizona stream. Outlines conditions to be met in the locality of diversion. Discusses features of dam and canal headwork design, pointing out those relative to the transportation, deposition, and removal of silt. Presents details of construction of Granite Reef Dam, Salt River, Ariz.

HARRIS, ELMO G.

1. Effects of dams and like obstructions in silt-bearing streams. Engin. News, vol. 46, no. 7, pp. 110-111, illus., Aug. 15, 1901.
A stream flowing through alluvium will cut away material of the channel at some places and silt up the channel at others and, as a result, will establish a definite slope dependent on volume of water and on character of material through which the channel is cut. Steeper grades will cause erosion while lesser grades will allow deposits of silt. The stream re-establishes grade by silting after the obstruction is introduced or by cutting after the obstruction is removed. New surface lines extend upstream.
2. The effect on meadow lands of back water from dams [letter to editor]. Engin. News, vol. 48, no. 16, p. 316, Oct. 16, 1902.
In answer to S. P. D's request for information regarding the effect of backwater from dams on meadow land (Engin. News, Sept. 11, 1902). Refers to article on the Effect of an Obstruction on Silt Bearing Streams (Harris, E. G., 1), in which he concludes that an obstruction in a silt-bearing stream causes silting extending upstream, a new surface line tending to become parallel to the first.

HARRIS, IRVING C.

1. How turbid Colorado River water was made fit to drink. *Engin. News-Rec.*, vol. 96, no. 22, pp. 896-897, illus., June 3, 1926.
Describes details of construction and operation of the El Centro, Calif., water purification plant, including method of removal and disposal of silt from the bottom of settling reservoirs.
2. Filling of Lake Mead. *Reclam. Era*, vol. 28, no. 12, p. 252, illus., Dec. 1938.
Presents an account of progress in filling Lake Mead Reservoir, 1935-38. Briefly notes measures employed to prevent silt from passing through penstocks, valve outlets, and turbines.

HARRIS, RICHARD J.

1. (and Irvine, Thomas D.). The determination of the volume of silt in the Wabash River and the technique of silt measurement. 25 pp., June 1931.
Unpublished thesis - Rose Polytechnic Institute, Terre Haute, Ind.
Describes an experimental study to determine the silt content of the Wabash River at Terre Haute, Ind., January-June 1931. Silt samples are discussed and the design of a new type of sampler, consisting of a pitcher pump and rubber hose, is described. Samples are analyzed by filtering and igniting the filter paper. A simple method of calculating total silt load from a few samples is described. Tabulation of results of the survey is included.

HARRIS, WADE H.

1. The May flood (1901) in the Southern Appalachian Region. I. In the Catawba River Valley, North Carolina. *Forestry and Irrig.*, vol. 8, no. 3, pp. 105-109, illus., Mar. 1902.
Describes the effects of the flood of May 1901 in the Catawba River Valley, N. C. Conditions of erosion and deposition are briefly noted. States that sand deposits on some bottom lands varied from 2 to 8 ft. in depth.

HARRISON, JOHN TURNHILL.

1. On the obstruction to navigation in tidal rivers. *Inst. Civ. Engin., Minutes of Proc.*, vol. 8, pp. 310-330, illus., 1849.
Discusses circumstances which affect the action of water and the deposition of solid matter. Notes observations on the motion of water in rivers and estuaries. Comments on presence and removal of bars. Gives mode of carrying out improvements in tidal rivers.

HARROD, B. M. See also McMath, R. E., 6; OCKERSON, J. A., 4.

1. Velocity and sediment. *Science*, vol. 5, no. 123, pp. 478-480, June 12, 1885.
Presents results of observations on velocity and sediment in the lower Mississippi River which contradict Login's conclusion that the power of water to hold matter in suspension varies directly with velocity and inversely with depth.
2. Caving banks on the Mississippi River. 14 pp., 1886.
Deals with the causes and effects of bank caving in the Mississippi River, conditions of sediment transportation and deposition, results of velocity and sediment observations in the stream, the conditions and amount of caving of banks, the effect of contraction works upon conditions of bank caving, and the proper use of bank revetment in connection with contraction works.
3. The dangers threatening the navigation of the Mississippi River. *Amer. Soc. Civ. Engin., Trans.*, vol. 7, pp. 243-251, illus., Sept. 1878.
Discusses the effects of civilization upon the regimen of the Mississippi River. States that cultivation has been the cause of greater and more violent floods, while levees have raised the surface and increased the velocity of the current, with consequent caving of the banks, increased frequency of cut-offs, and deterioration of navigation. Traces the history of cut-offs on the Mississippi to establish a connection between a disturbed regimen and disasters to reclamation and navigation. States that one-third of centuries-old cut-offs on a 600-mile stretch from the Tennessee line to Pointe Coupee occurred within the past 45 yr. from causes given above. Gives record of a ruinous cut-off during the flood of 1867 below Vicks-

burg. Proposes construction of a complete levee system which will allow for sufficient prolongation in the bends to give required reduction in slope, prevent cut-offs by bank revetment, and encourage a dense growth on the banks between the levee and the river. Any works designed to aid in establishing a low water channel for navigation improvement should preserve the capacity of discharge of the channel.

4. Caving banks. *Assoc. Engin. Societies, Jour.*, vol. 42, no. 1, pp. 36-41, Jan. 1909.
Describes bank caving on the Mississippi River and discusses the need for revetment works for the permanent location of the river's bed and banks.

HARROLD, L. L.

1. Floods in the Navajo country. *Soil Conserv.*, vol. 7, no. 7, pp. 172-173, illus., Jan. 1942.
Describes briefly the phenomenon of the movement of flood water and debris in the Navajo country and presents some preliminary results of research on the effects of diverted arroyo waters and their sediments upon native vegetation and soil.

2. (and Dickson, A. J.). Runoff yield, peak flows, and erosional material in runoff water from the watersheds of the Navajo Conservation Experiment Station, Mexican Springs, N. M., 1939-1941. 5 pp., illus. Washington, U. S. Soil Conserv. Serv., Off. Res., 1943.

Deals with hydrologic data obtained from the watersheds of the Navajo Conservation Experiment Station in northwestern New Mexico. Includes data on the annual erosional material in water passing through the runoff measuring stations at Mexican Springs, Chusca, and Yazzie.

3. Compilation of rainfall and runoff from terraces C5, C6, and C7 and watersheds C8 and W23 of the Central Piedmont Soil and Water Conservation Station, Statesville, N. C., 1933-1938. U. S. Soil Conserv. Serv., SCS-TP-52, 5 pp., illus., Mar. 1944.

Presents hydrologic data for various watersheds and terraces of the Central Piedmont Soil and Water Conservation Station, Statesville, N. C. Describes the watersheds and terraces. Soil loss is given in tons per acre.

4. (and Krimgold, D. B., and Westby, L. A.). Preliminary report on watershed studies near Waco and Garland, Texas. U. S. Soil Conserv. Serv., SCS-TP-53, 22 pp., Apr. 1944.

Presents hydrologic data for the design of farm ponds in the black-land prairies of Texas. Discusses rainfall, runoff, evaporation, seepage, erosion, silting, relation between hydrologic factors and pond dimensions, and application of data in design of farm ponds. Under erosion and silting of farm ponds, presents a table giving the estimated average annual amounts of silting in reservoirs with storage capacities ranging from 0.2 to 0.5 acre-feet per acre of drainage area under different slope and land use conditions.

5. Soil loss as determined by watershed measurements. *Agr. Engin.*, vol. 30, no. 3, pp. 137-140, illus., Mar. 1949.

A progress report dealing with a few years of field measurements of soil loss as affected by land use treatments at the North Appalachian Experimental Watershed, Coshocton, Ohio. Gives results of studies which are useful in conservation and farming practices. Notes that the reduction of soil loss through conservation farming will reduce reservoir sedimentation.

HART, R. A. See Fortier, S., 2.

HART, WILLIAM L.

1. The probability curve. *Amer. Water Works Assoc. Jour.*, vol. 7, no. 6, pp. 811-820, illus., Nov. 1920.
Gives an example as to how the normal probability curve arises naturally in certain problems of a statistical nature. Describes useful properties of the normal curve.

HARTS, WILLIAM W. See also Chittenden, H. M., 1; Foote, A. D., 2; Hall, W. M., 1; Watt, D. A., 1.

1. Debris-restraining barriers of the Yuba River. *Sci. Amer. Sup.*, vol. 58, no. 1507, pp. 24152-24154, illus., Nov. 19, 1904.

- Describes plan of the California Debris Commission for the treatment of the Yuba River which has been affected extensively by hydraulic mining operations.
 2. The control of hydraulic mining in California by the Federal Government. Amer. Soc. Civ. Engin., Trans., vol. 57, pp. 1-30, illus., Dec. 1906.

Discusses Federal control of hydraulic mining in California. Notes vast quantities of gravel handled by placer miners, influence of gold discovery, on growth of State, and damage to agriculture by debris in streams. Outlines legal steps resulting in throttling of the hydraulic mining industry in 1880. Concludes from observations in other river basins that the Sacramento basin moves between 5,600,000 and 43,000,000 cu. yd. of sediment per annum. Defines duty of a stream. Traces development of the levee system on the Yuba River. Discusses work of the Commission since its formation in 1893, its successful use of dams below mines, and the construction of various types of barriers and training walls on tributaries of the Sacramento, Feather, and other California Rivers.

Discussion: H. H. WADSWORTH, pp. 31-33, describes the effects of the Yuba River Flood of January 1905 on conditions of debris deposits behind the Yuba River Debris Barrier No. 1. J. D. GOLLOWAY, pp. 34-36, notes that temporary brush and log barrier dams on the various forks of the Yuba River are subject to rapid decay. Notes failure of head dam of Bay Counties Power Co., located above Colgate, resulting in the washing down of impounded debris. Comments on Harts' lack of data relative to the capacities of the basins, above Barrier No. 1, in order to estimate their ability to impound debris. H. DE. C. RICHARDS, pp. 36-38, describes briefly the effect of hydraulic mining operations on conditions of debris transportation and deposition in the Klamath and Trinity Rivers and their tributaries; notes in particular the effect of landslides. STEPHEN E. KIEFFER, pp. 38-42, notes the use of dredges on Feather River to cover the bed with coarse cobbles to prevent the movement of unstable surface sands and fine gravel in the stream bed. States that the volume of gravel mined and dumped into streams of the Sacramento River basin exceeds an estimated 760,000,000 cu. yd. THE AUTHOR, pp. 42-44, considers the possibility of mining hydraulic banks by the method of dredging. States that the Yuba River restraining works provide sufficient storage for detritus. Results of a survey by the writer on Bear River show the desirability of dredging operations; dredge material could be placed on levees along the Feather and Sacramento Rivers. The effect of operations would be to increase the navigability of rivers, prevent flood damages, dispose of deposited debris, and prevent further sedimentation.
 3. The debris from hydraulic mining in California. Forestry and Irrig., vol. 13, no. 9, pp. 471-475, illus., Sept. 1907.

Deals with the regulation of hydraulic mining debris in California by the Federal Government, work of the Debris Commission in controlling the output of debris from mines and treatment of the larger tributaries of the Sacramento and San Joaquin Rivers to prevent enormous quantities of debris in their beds from reaching the navigable streams; construction of high dams to catch and store heavy material, use of embankments and basins as settling pools for finer debris, and use of training walls to control flow in selected channels and prevent the movement of debris; Yuba River project; and proposed treatment of Bear and American Rivers.
 4. Improvements of inland rivers. Prof. Mem., vol. 1, no. 2, pp. 75-107, illus., Apr./June 1909.

Contraction work as a means of channel improvement is discussed, noting its effect on silting and scouring. Notes use of fixed dams such as on Kentucky, Green, and Muskingum Rivers without danger that pools might fill up with sediment. Describes method of dredging to prevent sediment deposits in dredged portions of channel.
 5. Forestry and stream flow. Engin. Assoc. of the South, Proc., vol. 21, no. 3, pp. 20-46, Feb. 21, 1910.

Deals with the effects of forestry on precipitation, stream flow, and sediment deposition in streams. Cites instances in America and Europe to show that deforestation does not cause silting in rivers.
 6. The relation of forests to stream flow. Engin. News, vol. 63, no. 9, p. 245, Mar. 3, 1910.

Study pertains to the Cumberland and Tennessee Rivers, and refutes statements that deforestation of river basins results in higher floods and lower low waters. Includes one paragraph noting that there has been no falling off of the navigable capacity of Cumberland or Tennessee Rivers due to silting up of channels or other causes.
 7. Improvement of rivers. Prof. Mem., vol. 5, no. 20, pp. 139-161, illus., Mar./Apr. 1913.

Engineering methods used in river bed and bank improvements and economic aspects of dredging are discussed. Data on contraction work in Europe and the United States are presented in detail. Regulation by dredging supplemented by contraction works is discussed. The Tennessee River is cited as a fair example of several types of work. Use of canals and reservoirs to aid stream navigation is examined. Sedimentation in lateral canals is a problem in maintenance.
- HARTWELL, O. W.
1. Surface water supply of New Jersey to September 30, 1928. N. J. Dept. Conserv. and Devlpt., Div. Water, Bul. 33, 301 pp., illus., 1929.

Presents discharge data on New Jersey streams to Sept. 30, 1928. Data on analyses of typical samples of surface waters and dissolved and suspended load determinations are included.
- HARVEY, W. B.
1. Discharge observations. Punjab Engin. Cong. Minutes of Proc., vol. 7, pp. 49-62, 1919.

Gives methods of measuring discharge into irrigation delivery canals. Discusses the effect of silt waves.
- HARZA, LEROY F. See also La Rue, E. C., 2.
1. Continuous records are needed in the study of retrogression. Engin. News-Rec., vol. 112, no. 26, p. 838, June 28, 1934; also in Assoc. Chinese and Amer. Engin. Jour., vol. 16, no. 1, pp. 23-25, Jan./Feb. 1935.

Comments on retrogression on a dam on the Wisconsin River and the need for continuous records.
 2. The Loup River public power plant. West. Soc. Engin. Jour., vol. 43, no. 5, pp. 234-240, illus., Oct. 1938.

Describes the engineering features of the Loup River hydro-electric development, Nebr. Briefly describes features of the diversion dam designed to prevent upstream accumulations of silt and downstream removal of stream-bed materials. An enlarged section of the diversion canal at the intake structure acts as a settling basin; a floating suction dredge pumps settled sediment from the basin into a trough from which it is discharged downstream.
- HASLAM, G. S.
1. (and Hall, C. H.). Use of ultra-violet light in the microscopic measurement of particle size. Franklin Inst. Jour., vol. 209, no. 6, pp. 777-789, illus., 1930.

Considers the use of ultra-violet light in the microscopic measurement of extremely fine particles. This method is of use for particle-size measurements of pigments of colloidal dimensions.
- HASWELL, CHARLES H.
1. Report of the result of observations upon the deposit of silt in the harbor of New York, made during the years 1854-1857. Franklin Inst. Jour., vol. 65, pp. 161-168, 1858.

Report to A. B. Neilson, president of the Board of Underwriters, New York, relative to results of observations (1854-59) on the deposits of silt in New York harbor which may reduce the tidal volume in the rivers, and a recommendation to overcome the impediment traced to earth-wash from the streets and sewers of Brooklyn and New York. Water tests covering a period of about three years indicate that the annual flow of silt into the rivers, as compared to water, was 1 to 12565, and that the volume of deposit from the water in the slips (at half tide) was 1 to 3610 exclusive of other detritus deposits not in suspension. As corroboration of these findings, the proprietors of the New York Sectional Dock advised that dredging under their dock to the depth of 7 ft. was a biennial necessity. Fearing a lateral and vertical reduction of the channel, it was recommended that the streets and piers of both cities be thoroughly cleared and that transfer to the river channel of materials dredged from the slips be forbidden. The navigable condition of the outlet of a tidal river can be maintained only by tidal water.

HATCH, F. H.

1. (and Rastall, R. H., and Black, Maurice). The petrology of the sedimentary rocks. Ed. 3, rev., 383 pp., illus. London, George Allen & Unwin, Ltd., 1938.

A textbook on the petrology of sedimentary rocks which treats of environments of deposition, influence of climate on deposition, and origin and classification of sedimentary deposits. Discusses the transportation of fragmental and soluble materials by rivers, noting methods such as rolling, saltation, suspension, colloidal solutions, and true solutions. Notes various types of deposits such as fragmental, rudaceous, arenaceous, argillaceous, calcareous, organic, and chemical. Considers briefly compaction and expulsion of water in a newly deposited sediment. Discusses soil forming processes and soils. Deals with the origin and shape of quartz grains. Contains an appendix by Thomas Crook, revised by Dr. F. Cole Phillips, which gives characteristics of common minerals for use in identifying them under the petrographic microscope.

HATCH, HARRY H. See Slade, J. J., 1.

HATCH, THEODORE.

1. (and Choate, Sarah P.). Statistical description of the size properties of non-uniform particulate substances. Franklin Inst. Jour., vol. 207, no. 3, pp. 369-387, Mar. 1929.

Attempts to define particle size by means of well-known statistical methods. Defines particle size in terms of the size-frequency curves of non-uniform particulate substances. Indicates the mathematical laws of the relationship between particle size as defined and certain properties of size of non-uniform particulate substances such as the number of particles per gram and the specific surface of the substance.

2. (and Choate, Sarah P.). Measurement of polarization of the Tyndall beam of aqueous suspensions as an aid in determining particle size. Franklin Inst. Jour., vol. 210, no. 6, pp. 793-804, illus., 1930.

Treats the use of the measurement of the polarization of the Tyndall beam for determining particle size.

3. Determination of "Average particle size" from the screen-analysis of non-uniform particulate substances. Franklin Inst. Jour., vol. 215, no. 1, pp. 27-37, illus., Jan. 1933.

Gives a method of treating screen-analysis data of non-uniform particulate substances. Considers the calculating of various average diameters from the parameters of a curve acquired by screen analysis.

HATHAWAY, GAIL A. See also Gottschalk, L. C., 12.

1. Sedimentation problems related to floodways, navigation channels and harbors. Fed. Inter-Agency Sedimentation Conf., Denver, 1947, Proc., pp. 18-24, 1948.

Deals with sedimentation problems related to floodways, navigation channels, and harbors.

Presents the sedimentation problems encountered by the U. S. Corps of Engineers in various rivers, navigation channels, and harbors in the United States. Discusses debris flows and beach erosion.

Discussion: ELLIOTT M. FLAXMAN, pp. 24-25, describes the movement of gravel on streams in the Northwest and Northeast. Suggests that the development of maintenance in harbors can be foreseen by comparison to a hypothetical reservoir on the same stream. CARL B. BROWN, p. 25, mentions the cost of dredging Baltimore harbor. GERARD H. MATTHES, pp. 25-26, believes that current definitions of "sediment" should include those solids normally transported in solution. J. W. DIXON, p. 27, reviews several problems pointed out by Mr. Hathaway. RALPH F. RHODES, pp. 27-28, describes the sedimentation problem in the Savannah River, Ga., and streams on the south Atlantic coast. Gives chart showing maintenance costs for four Atlantic and one Gulf coast harbor.

2. Observations on channel changes, degradation, and scour below dams. Internatl. Assoc. Hydraulic Structures Res. Rpt. (1948) 2, app. 16, pp. 287-307, tables and graphs, Dec. 31, 1948.

Discusses the significance of sediment transportation as associated with channel changes below hydraulic structures. Considers such subjects as scour, sediment movement below dams, channel stabilization, etc. Notes channel changes below the John Martin, Fort Peck, and Denison Dams, and the structures on the Ohio River. Gives some suspended-load data. Gives various comments and conclusions concerning the problem.

HATLEY, CHARLES AUGUSTUS.

1. On the delta of the Danube and the provisional works executed at the Sulina mouth. Inst. Civ. Engin., Minutes of Proc., vol. 26, pp. 201-253, 1873; [abstract], Engineering, vol. 15, p. 336, May 16, 1873.

Describes the beneficial effects of provisional piers by maintaining a constant water depth on the bar at the Sulina mouth of the Danube River. The completion of provisional works in 1872, maintained a depth of the channel at 20 ft. A projection of piers resulted in deepening the sea bottom to the north of the piers, and retarded the growth of the banks and the decrease in the rate of advance of the delta.

HATT, W. K.

1. Flood protection in Indiana. Ind. Acad. Sci. Proc., pp. 149-156, 1914.

Discusses plans of the Indiana Flood Commission for flood protection works in the Ohio River watershed area in Indiana. Includes three paragraphs briefly describing the damages sustained from the flood of March 1913. Notes the extent of erosion and deposition in the lower White River basin.

HAUGEN, NILS P.

1. Pioneer & political reminiscences. Wis. Mag. History, (ser. 1) vol. 11, no. 2, pp. 121-152, illus., Dec. 1927.

Refers to the small appropriation in 1889 to dredge the harbor of Fever River at Galena, Ill., which is not now navigable.

HAUPT, LEWIS MUHLERBERG. See also Ripley, H. C., 1; Ockerson, J. A., 4.

1. The reaction breakwater as applied to the improvement of ocean bars. Amer. Soc. Civ. Engin., Trans., vol. 42, pp. 485-494, Dec. 1899.

Discusses the reaction breakwater, giving theory. Notes reaction vs. concentration, and gives the cost of construction.

Discussion: GEORGE Y. WISNER, pp. 512-516, compares improvements at the entrances to tidal harbors with improvements to harbors at the mouths of sediment-bearing streams such as the Mississippi, Brazos and Panuco Rivers, in connection with the maintenance of navigable depths.

2. The reaction breakwater as proposed for the opening of the Southwest Pass of the Mississippi River. Sci. Amer. Sup., vol. 50, no. 1285, pp. 20604-20606, illus., Aug. 18, 1900.

HAUPT, LEWIS MUHLENBERG, - Continued

Discusses various plans for the improvement of the Southwest Pass of the Mississippi River. Considers the physical problem involved in securing and maintaining a deep water channel through the pass. Describes the characteristics of the channel and bar at the mouth of the stream. A proposed plan for improvement is discussed. Brief data are given on rate of advance of bar.

3. The engineering problem at the Southwest Pass [letter to editor]. *Engin. News*, vol. 44, no. 15, pp. 250-251, illus., Oct. 11, 1900.

Comments on papers by Starling (Starling, W., 5, 6). Discusses the effect construction of parallel jetties would have on improvement of the mouth of the Mississippi River, and suggests that an effective and expeditious remedy can be accomplished by a single jetty, pending the creation of a normal section.

4. The erosion of river bends [letter to editor]. *Engin. News*, vol. 44, no. 17, pp. 283-284, illus., Oct. 25, 1900.

Reply to a published letter (Gillette, H. P., 1) which criticized the arguments and theories advanced by Haupt relative to erosion of river bends.

5. Reaction as an efficient agent in procuring deeper navigable channels in the improvement of rivers and harbors. *Amer. Phil. Soc., Proc.*, vol. 42, pp. 199-211, Aug. 5, 1903.

Deals with existing and proposed methods of securing navigable channels across ocean bars. Discusses the importance of considering the physical agencies associated with bar formation. Reaction as an agent in procuring navigable channels is considered.

HAUSER, E. A.

1. (and Reed, C. E.). Studies in thixotropy; development of a new method for measuring particle-size distribution in colloidal systems. *Jour. Phys. Chem.*, vol. 40, no. 9, pp. 1169-1182, illus., 1936. Describes a method which employs the super-centrifuge for making particle-size fractionations and measuring particle-size distribution curves of systems in the colloidal range.

HAWES, C. G.

1. (and Inglis, C. C.). Report on tests made on a model of the group of regulators at Oderolal at Mile 169 approximately of the Rohri Main Canal, Sind. Bombay Pub. Works Dept., Tech. Paper 26, 24 pp., illus., 1928.

Presents results of experiments on a model of a group of regulators at Oderolal, Rohri Main Canal, Sind, India, to determine the number and location of gauges for calculating discharges for all heads, to determine the loss in head through regulators designed for "no afflux" conditions, and to study conditions of distribution of flow at surface and bed to ascertain the behavior of regulators in regard to silt draw-off under various conditions of flow.

2. Note on the results of silt analyses carried out in the development and research division. Bombay Pub. Works Dept., Tech. Paper 53, pt. 1, 21 pp., illus., 1934.

Describes investigations to obtain data from silt samples from discharge sites at the same time as the discharge observations and measurements of slopes were made; analyses of the silt samples are used to investigate the relationship between silt composition and the value of Lacey's "f" which is obtained from discharge data. Includes a note on the method adopted for silt analysis in Sind. Gives time of settlement of particles through 10 cm. water at various temperatures.

HAWKINS, J. C.

1. Irrigation in the Union of South Africa. *Engineering*, vol. 128, pp. 278-280, Aug. 30, 1929.

Includes two paragraphs noting that since rivers carry high percentages of silt, graded from finely suspended clays to heavy boulders, storage of water would necessarily entail storage of silt. Notes use of Stoney sluice gates at Lake Mentz and Oliphant River dams to permit heavier silt to pass during flood periods.

HAWLEY, JOHN B. See also Taylor, T. U., 6.

1. Siltation of Austin and Lake Worth Reservoirs in Texas. *Engin. News-Rec.*, vol. 91, no. 20, p. 811, Nov. 15, 1923.

Compares the rate of silting of Lake Austin and Lake Worth at Austin and Fort Worth, Tex., respectively, particularly noting a previous paper on the silting of Austin Reservoir (Taylor, T. U., 4). Rate of silting of Lake Austin is extremely high as compared with other Texas reservoirs because of the small amount of storage per square mile of drainage area. A preliminary silt survey of Lake Worth is described, in which silt deposits varying from 3/4 in. to 3 ft. were found. Results of this survey are compared with the Lake Austin survey.

HAWORTH, ERASMUS.

1. The life history of a river. *Kans. Acad. Sci., Trans.*, vol. 22, pp. 51-70, 1908-09.

Discusses principles of river regimen and flood control; laws governing river processes; and fundamental importance of the law that carrying capacity of moving water varies as the sixth power of velocity, giving examples of transportation and deposition in accordance with these laws; and the dependence of stream aggradation and degradation on the balancing of velocities and loads.

HAWORTH, PAUL LELAND.

1. George Washington, country gentleman. 336 pp., illus. Indianapolis, Bobbs-Merrill Co., 1925.

A biography of George Washington which includes several paragraphs on his attempts to utilize Potomac River silt for improving the soils of Mount Vernon.

HAYAMI, SHOITIRO.

1. Hydrological studies on the Yangtze River, China. *Shanghai Sci. Inst. Jour.*, sect. 1, vol. 1, pp. 97-162, Mar. 1938.

The author derives a differential equation governing the suspension and transportation of small particles by turbulent motion. Discusses the derivation of the fundamental equation; considers its various aspects, including settling velocity, laminar motion, and turbulent motion. Gives solutions of the fundamental equation in special cases of one-dimensional, non-steady flow and two-dimensional steady flow.

2. A study of silt transportation by running water. *Shanghai Sci. Inst. Jour.*, sect. 1, vol. 1, pp. 175-198, illus., July 1938.

A differential equation which governs the suspension and transportation of small particles by turbulent motion is derived. Presents the solutions of the equation in some special cases. Discusses the application of the equation to scouring and silting of a stream bottom by turbulent motion and to the vertical distribution of small particles in a stream.

HAYMAN, R. J. See Dryden, L., 3.

HAYNES, B. C.

1. A density channel for illustrating fronts and occlusions. *Amer. Met. Soc. Bul.*, vol. 20, no. 2, pp. 37-38, illus., Feb. 1939.

Describes density channel experiments which demonstrate the occlusion process and the movement of fronts when two or three liquids of different densities are permitted to form well-defined layers in the experimental tank. Illustrates convection and cumulus spreading-out under an inversion due to heating of the lower fluid.

HAYWOOD, OLIVER G. See also Einstein, H. A., 4.

1. Flume experiments of the transportation by water of sands and light-weight materials. 122 pp., 1940. Unpublished thesis, (D. Sc.) - Massachusetts Institute of Technology.

Deals with an analysis of experimental data obtained from laboratory flume investigations conducted by the U. S. Waterways Experiment Station, Vicksburg, Miss. The experimental work was done mainly with sand mixtures, and an analysis was made of the effect of flume walls. Studies several critical tractive-force formulas and concludes that the one by Dr. A. Shields is the most reliable. Compares formulas proposed by Schokitsch, Krey, Kramer,

- Indri, Casey, Chavy, White, and Shields. Notes a new formula for bed-load movement proposed by the Swiss Federal Institute of Technology. Analyzes the formation of waves and ripples as a function of grain size.
- HAZEN, ALLEN. See also Hering, R., 1.
1. The clarification of river waters [abstract]. *Engin. Rec.*, vol. 39, no. 17, pp. 377-378, Mar. 25, 1899. Paper on the removal of material in suspension from river waters used as sources of water supply, presented before the Franklin Institute. Discusses causes, means of measuring, and conditions which control turbidity. Gives results of observations made on three unnamed Pennsylvania streams showing effect of flood flows on turbidity. Illustrates computations of turbidity showing that larger watersheds produce more turbid water at waterworks intake, increase periods of muddy water, and shorten periods of clear water. Discusses effect of reservoirs as sedimentation basins to induce deposition and reduce turbidity and their use during flood flow for storage purposes only. Notes that size of reservoirs should vary directly with size of stream and periods of turbidity. Discusses the effect of filtration and coagulation in clarifying waters.
 2. On sedimentation. *Amer. Soc. Civ. Engin., Trans.*, vol. 53, pp. 45-71, illus., Dec. 1904. Discusses from a theoretical standpoint the processes which take place in sedimentation basins. States propositions and deductions with reference to sedimentation under various conditions. Discusses the velocity at which particles of sediment settle through still water and the effect of temperature flocculation and coagulation on sedimentation. Gives a comparison of different arrangements and designs of settling basins.
Discussion: GALEN W. PEARSONS, pp. 72-74, notes that the Missouri River carries a maximum of 1 part by weight of sediment in 673. Gives results of Flad's experiments on the rate of settling of particles in still water. Describes his own experiments relative to the effect of velocity on subsidence of sediment particles in sedimentation basins. ROBERT SPURR WESTON, pp. 74-77, describes experiences with small subsiding basins at New Orleans. GEORGE W. FULLER, pp. 77-87, notes the effect of temperatures on subsidence of sediment and distribution of deposited sediment in basins. THE AUTHOR, pp. 87-88, clarifies points put forth by the discussers.
- HEADDEN, WILLIAM P.
1. Colorado irrigation waters and their changes. *Colo. Agr. Expt. Sta. Bul.* 82, 77 pp., June 1903. Presents and discusses results of sanitary and chemical analyses of irrigation waters of the Colorado River and tributaries. Data are presented and discussed on origin, character, and chemical analysis of suspended matter carried in flood water of Poudre River (May 22, 1902), in Arthur Ditch water (July 5, 1900), and in Welch Ditch water (Aug. 27, 1902); and of deposited silt from Queen Reservoir, Promers County, Colo. (Jan. 23, 1903).
 2. Irrigation waters and their effects. *Colo. Agr. Expt. Sta. Bul.* 83, pp. 1-16, Oct. 1903. Discusses conclusions arrived at by writer relative to Colorado irrigation waters and their changes (Bul. 82). Considers briefly the fertilizing value of suspended matter carried by irrigation waters in the South Platte and upper Arkansas River basins in Colorado.
- HEARN, GORDON. See Griffith, W. M., 1.
- HEARN, W. E. See Holmes, R. S., 2.
- HEATH, A.
1. Siltation problem in planning our future water storages. *Land [Sydney]*, no. 1750, p. 15, June 15, 1945. Comments briefly on the Australian silt problem in several reservoirs. Notes useful life of reservoirs in the United States. Considers damage by debris in Los Angeles due to storms and the increase in such damage in Australia. States need to tackle problem at its source on watersheds and slopes.
- HEAVEY, W. F. See Vogel, H. D., 9.
- HEBERT, D. J. See Simmons, H. B., 1.
- HEDBERG, HOLLIS D.
1. The effect of gravitational compaction on the structure of sedimentary rocks. *Amer. Assoc. Petrol. Geol. Bul.*, vol. 10, no. 11, pp. 1035-1072, illus., Nov. 1926. Discusses the lithification and induration of sediments in connection with compaction; lithification resulting chiefly from decomposition (volatilization of organic material); recrystallization caused by pressure and diastrophic forces; elimination of intergranular pore space; the initial porosity of sediments as factors of grain size and slope; method of packing; and degree of uniformity, noting importance of adsorption in muds. Describes experiments on initial porosity of various sediments and gives results. Discusses conditions of reducing pore space by elimination of interstitial water; changes in mode of packing; reduction in particle size, etc., caused by lateral and gravitational pressure, minor earth movements, and influence of time; consolidation of principal sedimentary rock types by cementation and infiltration, compression, and recrystallization. Factors affecting compaction in water-deposited fine-grained sediments are noted. Describes study on compressibility of clays and shale showing relationship of porosities of shale to known overburdens. Examines porosity data. Discusses the influence of vertical compaction of structures. Application of quantitative data to two cases in Kansas is considered, suggesting the value of application to other areas. Suggests use of porosity as index of pressure metamorphism.
 2. Gravitational compaction of clays and shales. *Amer. Jour. Sci.*, (ser. 5) vol. 31, no. 184, pp. 241-287, illus., Apr. 1936. Deals with such subjects as historical development of ideas on pressure-volume relations in clays and shales, methods and definition, previous work on depth-porosity relations, analysis of data from well sections in Venezuela, general relation between pressure and porosity of clays and shales, and processes involved in the compaction of clays and shales.
- HEDBERG, JOHN.
1. Designing stable channels and computing bed-load movement. *Civ. Engin.*, vol. 7, no. 3, pp. 227-228, Mar. 1937. Presents a mathematical calculation of bed-load movement based on an experimental formulation by Prof. E. Meyer-Peter and associates at the "Versuchsanstalt für Wasserbau der Federal Technical University, Zurich, Switzerland." Gives formulas and typical calculations for the design of a trapezoidal channel in which bed load would be in equilibrium, i. e., would not move down stream. The calculation is applicable only to two-dimensional problems and to bed-load material 1/8-2 in. in diameter. Experimental constants hold for a wide range in specific gravity. The formula is dimensionally correct and is related to Froude number. Usefulness of the formula in natural streams, and difficulties of bed-load measurement and efficiency of bed-load sampling buckets (40 percent efficiency for experiments in progress), are discussed.
- HEINDENSTAM, A. V. HUGO VON.
1. The great Yangtze Bar. *Amer. Soc. Civ. Engin., Trans.*, vol. 93, pp. 102-119, illus., 1929. Describes the engineering investigations on conditions of the great Yangtze Bar for the purposes of improving navigation of the Port of Shanghai. The magnitude and physical aspects of the bars and dredging possibilities are described. Conditions of erosion and the deposition of silt by the Yangtze River as a controlling factor for the limitations of navigation requirements are examined. Investigations by the writer, 1914-24, on the possibilities for improving Shanghai Harbor are given. A proposal for dredging the south channel and for the construction of wharves in Whangpoo River are described together with the difficulties involved. The appendix includes data relative to stream velocity, stream discharge, silt content of

stream, general geological structure of estuary, consistency of mud in Whangpoo, and meteorological data.

Discussion: A. W. ROBINSON, pp. 120-124, presents a general method of dredging, depending on the type of material to be removed. Compares methods of Mississippi River forward feed dredging and English pocket dredging. Examines the question of increasing precipitation of dredged sediment in hoppers and the problem of stability of completed channel. R. L. VAUGHN, pp. 124-126, compares the use of the hydraulic hopper and pipe-line dredges, noting advantages of the latter in dredging operations in the Yangtze estuary.

HEINLY, BURT A.

1. Making a stream excavate its own reservoir and build its own dam. *Munic. Engin.*, vol. 39, no. 1, pp. 10-12, illus., July 1910.

Describes the construction of the Silver Lake hydraulic-fill dam, Los Angeles River, Calif. Notes use of hydraulic jets in cleaning silt from the emptied Buena Vista Reservoir in January 1910.

HELLMAN, N. N.

1. (and McKelvey, V. E.). A hydrometer-pipette method for mechanical analysis. *Jour. Sedimentary Petrology*, vol. 11, no. 1, pp. 3-9, illus., Apr. 1941; [abstract], *Geol. Soc. Amer.*, *Bul.*, vol. 51, no. 12, pt. 2, p. 1929, Dec. 1, 1940.

Describes the apparatus which is a small sensitive hydrometer enclosed within a pipette case. Gives method of sample taking. States that mechanical analysis by this method can be made in the field and would be designed to supplement accurate analyses made in the laboratory.

2. [Review of] Ionic effects on the rate of settling of fine-grained sediments, by L. R. Dreveskracht and G. A. Thiel. *Jour. Sedimentary Petrology*, vol. 12, no. 1, p. 52, Apr. 1942.

Reviews the paper (Dreveskracht, L. R., 1) which is concerned with the study of settling rates of 10 fine-grained materials suspended in solutions of potassium chloride, magnesium chloride, sodium chloride, and distilled water. Notes the results of the experiments.

HELLSTROM, B. See Matthes, G. H., 5.

HEMPHILL, R. G.

1. Irrigation investigations in Texas. *Amer. Soc. Agr. Engin., Trans.*, vol. 19, pp. 126-132, 1925. Describes irrigation investigations in Texas of the U. S. Department of Agriculture and the Texas Board of Water Engineers. Includes discussion on silt in Texas streams. The Brazos River investigation is noted. Describes silt sampling, sampling device, weight of dry silt, distribution of silt in stream, amount of bed load, and amount of silt deposition in representative reservoirs. Preliminary results on the rate of silting of a North Texas reservoir are given.

2. Silting and life of southwestern reservoirs. *Amer. Soc. Civ. Engin., Trans.*, vol. 95, pp. 1060-1072, illus., 1931; also in *Amer. Soc. Civ. Engin., Proc.*, vol. 56, no. 5, pp. 967-979, illus., May 1930; [abstract], *Engin. and Contract.*, vol. 69, no. 6, pp. 245-247, June 1930.

Presents records of the silt loads of several principal streams of the Southwest in order to show the importance of the silt problem and to stress the need for comprehensive study of this problem to cope with future water storage requirements. Describes the hydrology and topography of the region, noting in particular, the quantity and effects of silt in streams. Notes that the Colorado River discharges 137,000 acre-feet of bed and suspended silt annually at the lower end of the Canyon section and that this load would reduce the capacity of the proposed reservoir at Black Canyon or Boulder Canyon 50 percent in less than 75 yr. Gila River carries 1.3 percent of silt by volume, and Roosevelt Reservoir and Salt River (tributary to Gila) silted 101,000 acre-feet in 20 yr., an estimated reduction of 50 percent in 160 yr. Suspended silt passing San Marcial is estimated at 19,739 acre-feet annually and bed silt

25 percent of that suspended (Follett), an estimated reduction of 50 percent in the capacity of Elephant Butte Reservoir at 61 yr. of service. The average inflow of silt into Lake McMillan on Pecos River is estimated at 2,400 acre-feet annually; silting of the lake at Austin, Tex., on the Colorado River proceeded, since the time of the dam failure, at the rate of 7 percent of its capacity annually due to the relatively small size of the reservoir in comparison to stream runoff. The average annual deposit in Lake Worth on Trinity River amounts to 1,065 acre-feet, completely filling the reservoir in about 45 yr. Sediment investigations on the Brazos River are described. Notes sampling apparatus, method of sampling, and laboratory methods employed. Gives annual suspended-load determinations for a 3 yr. period, October 1924 to September 1927, on Double Mountain Fork near Aspermont, on Brazos near Mineral Wells, at Waco, and at Rosenberg. Describes reservoir surveys at Medina Lake, Lake Worth, and Lake Kemp. Notes that silt accumulations in Medina Lake amounted to 2,692 acre-feet in 13 yr. and that deposits will equal capacity in 1,225 yr. Lake Worth silts at approximately 1,000 acre-feet per year; total depletion in 47 yr. Distribution of silt in reservoirs is noted. Discusses volume-weight relationship of deposited silt, bed-load determinations, proposed methods of removing silt from reservoirs, prevention of reservoir silting, and estimations relative to the effective life of reservoirs.

Discussion: T. U. TAYLOR, pp. 1073-1074, describes the extent of silting in the lake at Austin, Tex., 1913-29.

HENDRICK, J. E. See McMillen, J. H., 1.

HENDRICKS, BARNARD A. See Cooperrider, C. K., 1, 2.

HENNY, D. C. See also Foote, A. D., 2.

1. Columbia and Colorado Rivers compared [letter to editor]. *Civ. Engin.*, vol. 1, no. 15, p. 1404, Dec. 1931.

Comments on article in *Civ. Engin.*, Sept. 1931, by Mr. Tiffany. Notes comparison between Colorado and Columbia Rivers with reference to transportation of silt and its effect on reservoir capacity. Cites belief that average annual silting at Hoover Dam will be 75,000 acre-feet, and points out that Rio Grande silts up at the rate of 20,000 acre-feet per year.

HENRY, A. J. See Bates, C. G., 2.

HENRY, S. T.

1. Irrigation in Mendoza, Argentina. *Engin. News-Rec.*, vol. 85, no. 8, pp. 353-355, illus., Aug. 19, 1920.

History of irrigation and description of the project on the Rio Blanco. Notes the tendency of the river to transport, when in flood, great quantities of sand and gravel which is deposited behind the dam, reducing the tendency to undercut it. There are five groups of gates in the dam for the purpose of flushing accumulations of sand and gravel. Bank protection above the dam consists of levees planted with Lombardy poplars.

HENSHAW, GEORGE H.

1. The improvement of channels in sedimentary rivers. *Amer. Soc. Civ. Engin., Trans.*, vol. 20, pp. 109-116, illus., Mar. 1889.

Treats the improvement of channels in sedimentary rivers as illustrated by the Mississippi River. Gives brief geological history of the Mississippi River basin. Describes method of improving the river by contraction works and cites objections. Discusses method of supplying artificially to the channel bottom that element of resistance to erosion essential to an ideal river. Describes a device consisting of a loose-woven, permeable fence of light and flexible material and the method of laying it down. Also describes a supplementary structure.

HERAPATH, THORNTON J.

1. The improvement of land by warping, chemically considered. *Roy. Agr. Soc. England, Jour.*, vol. 11, pp. 93-113, 1850.

Discusses warping or restoring exhausted fertility of land by the application of sediment. Warping was first practiced in England about 1750 near Howden on the banks of the Humber.

Describes specific projects, including methods used, cost, and results obtained. Gives analyses of water used in warping, sediment, soils before and after warping, and crops produced during different years. Crop rotation and production records of various projects for different years are also given.

HERBERT, J. K. See Blue, F. L., Jr., 1.

HERING, RUDOLP. See also Crowell, J. F., 1.

1. (and Fuller, George W., and Hazen, A.). Experts report on water purification at Washington, D. C. Engin. News, vol. 45, no. 9, pp. 159-160, Feb. 28, 1901.

Reports on methods used for purifying the water supply of Washington, D. C. Compares observations on suspended matter of the Potomac River with that of the Merrimac River at Lawrence, the Hudson River at Albany, the Allegheny River at Pittsburgh, the Ohio River at Cincinnati and Louisville, and the Mississippi River at New Orleans. Notes that the factor of fineness of suspended matter and duration of periods of turbid water are to be considered in water purification. Discusses the adequacy of subsidence of sediment in reservoirs, the use of filters, and the use of coagulants.

HERION, G. A.

1. River bank protection. Soil Conserv., vol. 5, no. 1, pp. 6-9, illus., July 1939.

Comments on bank protection on the upper Gila River. Notes that revegetation of channel banks with a minimum of structural mechanical protection is the solution to effective bank-protection problems. Describes type of structural protection used on the Gila River, type of vegetal growth on banks, and planting methods employed.

HERMAN, ALBERT G. See Tolman, R. C., 2.

HERRMANN, F. C.

1. Small reservoirs in Wyoming, Montana, and South Dakota. U. S. Off. Expt. Sta. Bul. 179, 100 pp., illus., 1907.

Presents data on the design, construction, and maintenance of various small prairie reservoirs in Wyoming, Montana, and South Dakota, and discusses the factors to be considered in the future construction of small reservoirs in these regions. Presents brief data on conditions of silting in the Bull Creek, Indian Spring, Battle Creek, Montgomery, Cheese Factory, Roundout, and North Butte Reservoirs of the Chicago and Northwestern Ry., and in the privately-owned Oliver, Gray, Barbour, and Kidd Reservoirs. Briefly notes measures to be taken to control silting in small prairie reservoirs.

HERSHEL, CLEMENS. See also Frontinus, S. J., 1.

1. On the erosive and abrading power of water upon the sides and the bottom of rivers and canals. Franklin Inst. Jour., vol. 105, no. 5, pp. 330-338; no. 6, pp. 393-403; vol. 106, no. 1, pp. 26-28, May-July 1878.

Considers erosive and abrading power of water upon sides and bottom of rivers and canals. Gives history of engineering problem referred to in the Cape Cod ship canal (Mass.). Describes experiments of Dubuat (1780-84) to determine the effect of currents upon the bed of a channel and upon the transporting power of water. Gives J. Dupuit's theory of the transportation and deposit of alluvial matter based on the power of dragging along bottom material and the power of suspension of the stream. Describes observations of M. Minard on the power of the stream to carry material in suspension, of T. Login on whirling or rotary motion of water as affecting scour, of the author on lower Mississippi River bank erosion caused by irregularities in velocity, and conclusions of M. Fargue that shoals and pools and scouring power of a section of river are functions of situation and curvature of bends. Also discusses conditions of channel stability.

2. Note on the power of water to hold matter in suspension. Franklin Inst. Jour., vol. 106, no. 5, pp. 321-322, Nov. 1878.

Comments on note by Frizell (Frizell, J. P., 1). Criticizes Frizell's theory and defends Dupuit's theory relative to the ability of flowing water to retain material in suspension.

HEYWOOD, HAROLD.

1. Calculation of the specific surface of a powder. Inst. Mech. Engin. [London], Proc., vol. 125, pp. 383-459, illus., 1933.

Describes a method of calculating the specific surface of a powder which can be applied to all powders irrespective of the material from which they are derived.

2. Measurement of the fineness of powdered materials. Inst. Mech. Engin. [London], Proc., vol. 140, pp. 257-347, illus., 1938.

Treats in detail the methods of analysis for measuring the fineness of powdered materials which are used in engineering and industrial processes. Considers the motion of irregularly shaped particles in a fluid and gives a method of calculating the falling velocity when fluid flow around the particle is turbulent. Contains a bibliography of about 150 references concerned with the subject.

HIBBS, BEN.

1. Water to the sea. Country Gent., vol. 107, pp. 7-8, 69-71, illus., June 1937.

Discusses the need for genuine protective engineering as the most efficient palliative in flood control. States that erosion control and reforestation as correlated palliatives in flood control are in themselves inadequate since floods are not due largely to the destruction of forests and grasslands, the large rivers of today do not carry many times the amount of silt they did before the coming of white man, there is no general or continued trend of rise in the elevation of the bed of the Mississippi, and erosion control practices will not appreciably reduce the sediment content of the Mississippi since bank caving is the chief source of sediment in the stream.

HICKSON, R. E.

1. Changes at mouth of Columbia River, 1903 to 1921. Military Engin., vol. 14, no. 75, pp. 211-214, 257, illus., May/June 1922.

Describes the changes which have taken place in the hydrography of the mouth of the Columbia River since the commencement of jetty construction (1903) and subsequent to their completion (1917).

2. Shoaling on the lower Columbia River. Military Engin., vol. 22, no. 123, pp. 217-219, May/June 1930.

Results of surveys and observations made during the freshets of 1927 to determine the extent and time of shoaling in the lower Columbia River in order to provide for effective dredging. Describes the stream, noting in particular the characteristics of banks and bed. Data on screen analyses of material dredged from the channel at Morgan and St. Helens Bars are given. Discusses conditions of the transportation and deposition of material in the lower Columbia River; extent of shoaling at Vancouver, Morgan, Willow, St. Helens, Kalama, Slaughters, and Fisher; and influence of contraction works at St. Helens Bar. Nature and cause of shoaling are discussed. It is due principally to the movement of material along the bottom of the stream. Concludes that shoaling of bars continued with the falling of the river and that the crest or maximum volume of shoaling is not reached for 1-1 1/2 mo. after the crest of the freshet has passed.

HIDER, ARTHUR.

1. Report...upon observations at Lake Providence, November, 1879, to November 1880. U. S. Miss. River Comn. Rpt. 1882, pp. 80-88.

Records various observations and methods used to make observations. Concludes that bottom of the River is in an unstable condition and consists of a series of sand waves. Comments on travel of sand bars. Discusses movement of bed material. Various results are given.

HIGGIN, GEORGE M.

1. Experiments on the filtration of water, with some remarks on the composition of the water of the River Plate. Inst. Civ. Engin., Proc., vol. 57, pp. 272-293, illus., 1879.

Presents results of experiments on the purification of waters of the River Plate made at Buenos Aires in 1877. Contains data (pp. 272-275) on amount of silt in the Plate River.

HIGGINS, ELMER.

1. Progress in biological inquiries, 1930. U. S. Bur. Fisheries, Ann. Rpt., app. 3, pp. 553-626, illus., 1931.

A report of progress of investigations relative to fish and fish culture in the United States. Includes brief discussion on the effect of the deposition of erosion silt on bottom animals in the Mississippi River.

2. Progress in biological inquiries, 1931. U. S. Bur. Fisheries, Ann. Rpt., app. 3, pp. 441-529, illus., 1932.

A report of progress of investigations on fish and fish culture in the United States. Notes studies on erosion silt as a factor in many problems of fisheries; in inland river systems, including extent of silt deposits on bottoms of streams; mechanical action of silt deposition; effects of suspended and deposited silt on animal life in streams; erosion silt and oxygen demand; erosion silt and bacteria; and relation of erosion silt to industrial pollution.

3. Progress in biological inquiries, 1933. U. S. Bur. Fisheries, Ann. Rpt., app. 3, pp. 313-383, 1934.
A report of progress of investigations in fish and fish culture in the United States. Notes results of experiments on the proper maintenance of bottom conditions for mussels in artificial raceways so that the current will scour the bottom free of silt deposits. Harmful effects of erosion silt are considered.

HIGGINS, GEORGE. See also Todd, O. J., 10.

1. The Goulburn Levees [abstract]. Commonwealth Engin., vol. 4, no. 10, pp. 260-262, May 1, 1917.
Paper read before the Victorian Institute of Surveyors on flood and siltation of the Goulburn River Valley, also noting conditions in the Murray River, both rivers being in Victoria, Australia. Protection from floods by levees, dredging and other control works are noted. Process of erosion and silting is described in detail. Data needed to plan control measures are listed.

HIGHAM, T.

1. Supplementary note on silting operations. Punjab Pub. Works Dept., Irrig. Branch, Papers 5, pp. 15-19, Jan. 1896.
Notes that the warping or silting reaches described (Reid, A. G., 1) are worked on the multiple head or "in-and-out" system. Discusses and gives additional information on the article by Mr. Reid.

HILDER, ARTHUR. See Ockerson, J. A., 1.

HILGARD, EUGENE W.

1. On the geology of the Delta and the mudlumps of the Passes of the Mississippi. Amer. Jour. Sci. and Arts, (ser. 3) vol. 1, no. 4, pp. 238-246; no. 5, pp. 356-368; no. 6, pp. 425-435, 1871.

Discusses the general geology of the Mississippi River Delta. Treats of the origin of mudlumps noting that the theory advanced by Sir Chas. Lyell seems to be the only tenable one; this theory requires modifications as to the mass exerting the pressure and corollaries as to mode of action.

2. On the silt analysis of soils and clays. Amer. Jour. Sci., (ser. 3) vol. 6, no. 34, pp. 238-246; no. 35, pp. 333-339, 1873.

Deals with the silt analysis of soils and clays. Describes the apparatus and procedure used. Gives a table of diameters and hydraulic values of sediments covering the range from coarse grits (1-3 mm.) down to clay size.

3. Analyses of soils. Calif. Univ., Bd. Regents, Bien. Rpt., Sup., pp. 16-29, 1879.

Stresses the need for mechanical and chemical analyses of agricultural soils and presents results of analyses of surface soils from Placer, Los Angeles, and San Diego Counties, Calif. Comments and gives data on the chemical and mechanical analyses of soil from sediment of the Sacramento River, and of mining "slum," valley adobe, and "dry bog" soils.

4. The exceptional nature and genesis of the Mississippi Delta [abstract]. Science, n. s., vol. 24, no. 626, pp. 861-866, Dec. 28, 1906.

An article on the form and composition of lower Mississippi Delta. Notes that mudlump formations and consequent bird-foot mouths occur

only in the Mississippi. Describes mudlumps and their place in delta building. Agrees with Lyell that mudlumps are formed on the principle of "creeps." The phenomenon depends on the existence of the blue clay bottom under the lower Mississippi region. Escaping gas from mudlump craters indicates their swamp origin. Mudlumps as obstacles to navigation are discussed.

5. A new development in the Mississippi Delta. Popular Sci. Monthly, vol. 80, pp. 237-245, illus., Mar. 1912.

Considers the formation of "mudlumps" of the Mississippi Delta. Discusses the mechanism of mudlump upheaval, and gives a theory of the origin of mudlumps. Treats the possible forestalling of further mudlump upheavals.

HILL, ARTHUR.

1. Erosion and deposition by the Indus. Geol. Mag., vol. 7, pp. 289-290, July 1910.

Describes bank erosion and deposition of silt by the Indus River. Erosion of the bank at the apex of a curve in the stream was as much as 100 ft. per day. Local deposits often cover a square mile 60 ft. deep in two months. The estimated quantity of silt carried by the Indus in four months would cover 503 sq. miles 1 ft. deep.

HILL, H. O.

1. Soil conservation in Texas Blacklands. Civ. Engin., vol. 8, no. 2, pp. 109-112, illus., Feb. 1938.

Describes and proposes the application of various erosion-control and soil-conservation measures on watersheds of the Texas Blacklands. Notes that the economic aspects of reservoir silting necessitate these measures.

HILL, ISSAC.

1. Change in the course of rivers. Farmers' Monthly Visitor, vol. 2, p. 76, 1840.

Discusses bank erosion along the Merrimack River, at one point cutting several rods. At one point on the Merrimack a 74-gun ship could float, but 35 yr. later grass was cut at same point and where corn was once raised the center of the river is now.

2. The value of irrigation. Farmers' Monthly Visitor, vol. 6, p. 23, 1844.

Refers to a bridge which caused sediment deposition between Washington and Georgetown. At the time of Braddock's expedition, a British fleet of heavy ships moored in the river above Georgetown. Now it is with great difficulty that a ship of considerable size can float in the waters above the Washington Navy Yard.

HILL, LOUIS C. See also Kelly, W., 1.

1. Solving the silt problem. Engin. Rec., vol. 70, pp. 609-610, Dec. 5, 1914.

Deals with methods designed to solve the silt problem on the Colorado River and other silt-bearing streams of the Southwest. Notes the use of diversion dams to exclude silt from canals; the reduction in quantity of silt carried by the Colorado through control of flood waters; extended use of water for irrigation; and stream regulation. Observations on the Rio Grande showed that 1 1/8 percent by weight of river volume was silt in suspension. Deposited and compacted this silt weighed 75-80 lbs. per cu. ft. Notes provision made in plans of the proposed Elephant Butte Reservoir for a silt storage section and for increased height to provide storage for all silt brought down in 250 or 300 yr. Gives cost of silt storage provided at Elephant Butte Reservoir. Silt in suspension at Salt River was found to be 1/4 percent of the total flow. Roosevelt Dam on Salt River was raised 5 ft. to provide additional silt storage for a period of 50 yr. at a cost of 2 1/2 ct. per 1000 cu. yd.

HILL, RAYMOND A. See also Fortier, S., 2; GROVER, N. C., 12; Kelly, W., 1.

1. Silting of reservoirs formed by large dams; its measurement and prevention. Internatl. Cong. on Large Dams, 2d, Trans. 1936, vol. 5, pp. 203-206, 1938.

Considers the measurement and prevention of silting of reservoirs formed by large dams. Discusses possible effects of erosion control on rates of reservoir silting, extension of life span of reservoirs, reduction of available water

supply by increased transpiration and evaporation losses, and economic aspects of reservoir silting. Illustrates some elements of the problem by conditions at Elephant Butte Dam, noting loss in capacity in over 20 yr., due to silting, of 365,000 acre-feet, at the rate of 18,000 acre-feet annually, equivalent to 1.5 percent of the inflow. Although the total life of the reservoir should be 150 yr., additional storage capacity of 500,000 acre-feet may be needed in about 30 yr.

HINCKLEY, H. V.

1. Lessons from the Austin Dam failures. 7 pp., illus. Oklahoma City, Okla. Engin. Soc., 1911.
Discusses the causes of the failures of the dams at Austin, Tex., and Austin, Pa. Notes that at time of failure the capacity of the dam at Austin, Tex., was found to have been reduced 48 percent by silt deposits which accumulated at the rate of about 6,000,000 yd. per year.

HINDS, NORMAN E. A.

1. Geological evidences of recent floods. Amer. Geophys. Union, Trans., vol. 19, pp. 646-647, 1938.
Treats of geological occurrences of major floods comparable to those of modern times as evidenced by enormous masses of flood-plain deposits of fluvial origin in the Sacramento and San Joaquin Valleys. Causes of floods and need for flood protective measures are briefly noted. Discussion: C. J. KRAEBEL, pp. 659-660, considers briefly the need for erosion control measures on watersheds to prevent silting in stream channels. Notes conditions of increased flood stages on California streams due to silting up of flood beds. F. E. MATTHES, p. 660, notes additional data on the magnitude of present floods comparable to floods of glacial times in the Sierra Nevada Mountain Region.

HINKLEY, W. O.

1. Determination of particle size distribution for particle sizes between 40 and 1 or 2 microns. Indus. and Engin. Chem., Analyt. Ed., vol. 14, no. 1, pp. 10-13, illus., Jan. 15, 1942.
Describes a method for the determination of particle-size distribution which is a variation of the pipette method and depends on Stokes' law. Equipment, excluding the balance, costs less than \$5. Discusses use of dispersing agents.
Correction. Indus. and Engin. Chem., Analyt. Ed., vol. 14, no. 4, p. 297, Apr. 15, 1942.

HINTGEN, L. N.

1. Flood problems in Sioux City. Iowa Engin. Soc., Proc., vol. 40, pp. 103-108, 1928.
Deals with the existing and proposed stream improvements to the Sioux River and tributaries, Sioux City, Iowa. Describes the damages in Sioux City during the Floyd River flood of May 1892 and the Perry Creek flood of July 1909 due to the deposition of erosional debris.

HIRANANDANI, M. G.

1. Derivation of formulae along lines suggested by Mr. Inglis in his note on "Divergence in stable channels in alluvium" in report to Sind data. India Cent. Bd. Irrig. Pub. 29, pp. 72-73, illus., 1943.
Compares data of stable channels in Sind with Inglis formulas and reaches the conclusion that the latter are not applicable in Sind.
2. The design of proportional silt distributing and skimmer heads in Sind. India Cent. Bd. Irrig. Pub. 29, pp. 132-137, illus., 1943.
Analyzes results obtained with silt control devices at the heads of offtakes and conclusions drawn. Rules for design are given.
3. An investigation into the values of Kutter's, Lacey's & Manning's 'N's. India Cent. Bd. Irrig. Pub. 29, pp. 98-100, 1943.
Analyses data from channels in Sind statistically. Discusses conclusions arrived at.
4. A method of collection and determination of bed load. India Cent. Bd. Irrig. Pub. 29, pp. 114-115, illus., 1943.
Describes the design of a suction-type sampler for collecting sand moving on the bed.
5. Remarks on note No. C-295/CEE, dated 19th July 1941, by Mr. Gerald Lacey, on basic theory. India Cent. Bd. Irrig. Pub. 29, pp. 73-76, illus., 1943.

Uses the data of stable channels in Sind to compare the modified Lacey formulas with the originals. The associations between E and Q are verified, but the modified equations involving E do not meet with success in Sind.

6. Remarks on the note, "Effect of dynamic shape on Lacey's relations" by Messrs. Blench and King. India Cent. Bd. Irrig. Pub. 29, pp. 68-72, illus., 1943.

Comments on the relationships for the shape and slope of stable channels, prepared by Blench and King, in the light of the data on Sind channels.

HITCH, MARGARET A.

1. The Port of Tientsin and its problems. Geog. Rev., vol. 25, no. 3, pp. 367-381, illus., July 1935.
Describes the flood and silt problems of the Port of Tientsin, the existing temporary palliative scheme to remedy both problems, and a proposed permanent solution.

HJULSTROM, FILIP. See also Krumbein, W. C., 10.

1. Studies of the morphological activity of rivers as illustrated by the River Fyris. Uppsala Univ., Geol. Inst., Bul., vol. 25, pp. 221-528, illus., 1935.
Discusses the mechanics of streams and gives an account of the amount of mechanical sediment and dissolved matter in the River Fyris passing a profile just north of the town of Uppsala, Sweden, by days, between July 1, 1929 and June 30, 1934. In connection with the dynamics of streams, discusses the changes in position of a mass of water under the influence of gravity and its own kinetic energy either by falling or by flowing; the characteristic quality of laminar movement; laminar movement changes at certain critical velocities; the movement of water in sheet-flood erosion; the transition between laminar and turbulent regime; the nature and characteristics of turbulence; velocity variations due to turbulence (pulsations); influence of pulsations on erosion; distinction between a streaming and shoaling movement; cavitation; and other characteristic forms of movement in natural watercourses. Considers the problem of the transportation of solid matter in water as bed load and suspended load and, in this connection, discusses the effects of falling movement and hydrodynamical upthrust; the effect of the distribution of intensity of turbulence expressed by the Austausch-coefficient; and factors affecting the distribution of silt at different heights above bottom, along a vertical line, and over a cross-section. Discusses the relationship between erosion velocity and grain size for uniform and mixed materials; forms and conditions of erosion by running water in solid rocks; the origin, disappearance, and destructive influence of cavitation; erosion of solid rocks, glacio-fluvial erosion, and stream erosion by cavitation; deposition; problems covering the stratigraphy of a deposit; the motion of the bottom layer in stream transportation; the relationship of the phases of traction (dune, smooth, antidune) to transportation and scour; the capacity of transportation. Describes and gives results of an investigation on the amount of mechanical sediment and dissolved matter in the River Fyris to determine the rate of degradation of the river basin above Uppsala. Data are given on the geographical conditions of the basin, geology, vegetation, cultivation, climate, tributary rivers and lakes, and hydrology of the basin. Gives method of investigation, sampling procedure, and apparatus analysis of water samples; method of determining bed load; mechanical composition of suspended matter; distribution of silt in a cross-profile; silt content of the stream; calculated load of the River Fyris, correlation of fluctuations in transport with changes in weather; chemical composition of silt; dissolved-load determinations and rate of degradation of the Fyris River basin. A list of references is included.
2. The load of the River Fyris in central Sweden. Internatl. Geod. and Geophys. Union, Sect. for Sci. Hydrol. Bul. 22, pp. 74-82, illus., Mar. 1936.
Presents a summarized report of results of an investigation to determine the load of silt and

dissolved matter transported by the River Fyris, immediately north of Uppsala, Sweden, covering area investigated, hydrology, method of investigation, sampling procedure and apparatus and method of analysis, distribution of silt in cross-profile, total load transported by the stream, rate of degradation of the Fyris River basin, and the process of erosion within the basin of the River Fyris.

3. Transportation of detritus by moving water. In Trask, P. D., ed. Recent marine sediment; a symposium, pp. 5-31, illus. London, T. Murby and Co., 1939.

Summarizes various aspects of conditions of the transportation of detritus by moving water as applied to rivers. Discusses, in connection with laminar and turbulent flow, characteristics of movement and velocity of flow, and types of turbulent motion. The relationship of erosion, by rainwash on stream watershed and by scouring of river channel, to the transportation of detritus by streams is examined, together with the factors affecting the transport of detritus and the mode of transport. The collective movement of bed load, forming ripples, bars, and banks, is analyzed showing the effect of velocity, variations in transportation, and motion near the bottom of the stream. Factors affecting the distribution of silt at varying heights above bottom and the influence of settling velocity and turbulence are analyzed. Discusses, with relation to the total solids load, computations of load and variations in the sediment capacity of streams. Problems with reference to the transportation of detritus by streams are listed. Notes that the Mississippi River carries daily to the sea 2,000,000 tons of sediment. A bibliography is included.

HO, CHITTY. See also Mavis, F. T., 2.

1. Determination of bottom velocity necessary to start erosion in sand. 116 pp., June 1933. Unpublished thesis (Ph. D.) - State University of Iowa; [abstract], Iowa Univ., Studies in Engin. Bul. 19, p. 56, May 1939.

Reviews earlier studies to show how much is known and what is most urgently needed in further studies of the problem of transportation of sedimentary materials in flowing water. The main point of the study is to show the relationship between characteristics of bottom materials and the critical bottom velocities. The characteristics of bottom materials should be investigated and bottom velocity should be controlled in the design of irrigation canals on river-improvement works. Discusses briefly the methods used in improvement of alluvial rivers and gives suggestions for further studies.

HOAG, W. R.

1. Red River Valley drainage ditches; their repair and maintenance. Assoc. Engin. Societies, Jour., vol. 30, no. 4, pp. 180-190, illus., Apr. 1903. Describes conditions of silting and vegetable growth in the bottoms of drainage ditches of the Red River Valley, their repair and maintenance, and costs.

HOBBS, CLARK S.

1. [Letter to editor]. Land, vol. 1, no. 2, pp. ii, 124, illus., Spring 1941.

Comments on an illustration which depicts birds enjoying freedom on a stretch of the Patapsco River, Md., and which also shows evidence of deposits of silt which have filled the stream. States that the accumulation of silt for miles above and below the point portrayed render the river useless and are the result of deforestation and improper cultivation together with ignorance and indifference to soil conservation practices.

HOBBS, DERISLEY F.

1. Natural reproduction of quinnat salmon, brown and rainbow trout in certain New Zealand waters. New Zeal. Marine Dept. Fisheries Bul. no. 6, 104 pp., illus., 1937.

Presents an account of a preliminary investigation of the efficiency of natural reproduction of brown trout, quinnat salmon, and rainbow trout in certain New Zealand waters. Includes

discussion on the effect of silting on the development of alevins and eggs in redds (areas of relatively clean material in larger areas of normal stream bed). Data are given on losses in the redds due to flood-effects, redds washed away, redds left by the stream, deposition of material on redds, and surface scouring. The susceptibility to flooding of the streams under discussion is considered.

HOBSON, S. BONNIN.

1. Dam making experiences in the Karroo [letter to editor]. Cape of Good Hope, Dept. Agr., Agr. Jour., vol. 23, no. 2, pp. 196-198, illus., Aug. 1903. Describes method of constructing dams for stock-drinking purposes in such a manner as to avoid as much as possible silting and evaporation.

HOC.

1. Recherches sur la formation des sinuosités des cours d'eau (Research on the formation of sinuosités of streams). Le Genie Civil, vol. 74, no. 11, pp. 212-215, illus., Mar. 15, 1919; also in Engin. and Contract., vol. 52, no. 5, pp. 123-125, illus., July 30, 1919.

Discusses a theory tending to explain the sinuosités of river flow resulting from erosion and the deposition of silt. Compares it with the effect of bending flexible columns under longitudinal compression. States that any obstruction to flow may be considered as an artificial cause for compression and may result in local scouring or silting independent of concavity or convexity of the river bank. Gives examples of meanders in European rivers examined from the point of view of the theory.

HODGE, W. W.

1. (and Niehaus, E. J.). Ohio River water in the Wheeling district and its treatment for the use in boilers. W. Va. Engin. Expt. Sta. Tech. Bul. 8, pp. 41-66, illus., Apr. 15, 1936. Presents results of studies of Ohio River water in the Wheeling district, and methods of treating it for industrial use. Procedure for analysis of dissolved and suspended matter is given, and the results are tabulated and interpreted.

HODGESON, P. A.

1. Missouri River improvement. Kans. Engin. Soc. Proc., vol. 30, pp. 47-55, 1938. Describes design and construction details of improvement works on the Missouri River between Sioux City, Iowa, and the mouth, for securing a permanent navigable channel by means of bank revetment, permeable dikes to contract and stabilize waterways, removal of snags, and dredging.

HOLLAND, CHARLES EDWIN.

1. Gold content of river waters [letter to editor]. Mining and Metall., vol. 7, no. 229, p. 27, Jan. 1926.

Presents briefly the results of an investigation concerning the gold content of Colorado River water. Notes that 200,000,000 cu. yd. of gold-bearing silts pass through Grand Canyon annually, roughly 10 percent of which is deposited enroute in wide portions of the river and the remainder fed to the ocean. Assays run 4-15 ct. per ton of river water 125 miles from the canyon mouth, all of which bears commercial promise.

HOLLOPETER, CHARLES A. See Harper, H. J., 2.

HOLMES, FREDERICK C.

1. Timber-truss bridge and dam built by CCC labor. Engin. News-Rec., vol. 116, p. 526, illus., Apr. 9, 1936.

Describes the design and construction of the timber-truss bridge and drop-log type dam at Windsor, Mass. This type dam was chosen because of the ease of silt removal.

HOLMES, GARNETT J.

1. Soil survey of the Yuma area, Arizona. U. S. Bur. Soils, Field Oper., Rpt. (1902) 4, pp. 777-791, illus., 1903.

Presents results of a soil survey in the Yuma area, Ariz. Includes an outline of the history of organized irrigation in the district, and notes the problem of silting in irrigation ditches. Presents brief data on characteristics of the alluvial soils of the district.

HOLMES, GLENN W. See also Griffith, W. M., 2.

1. Determination of suspended solids in sewage by light absorption. *Sewage Works Jour.*, vol. 7, no. 4, pp. 642-657, illus., July 1935.

Treats the case of the electronic cell for determining the degree of light absorption by sewage. Notes that comminution of the larger suspended solids improves the relationship between concentration of suspended solids and light absorption and that light absorbed through 1/2 in. distance in sewage bears a closer relationship to the concentration of suspended solids in sewage than light absorbed through a greater distance.

HOLMES, R. S.

1. Some observations on Ohio River alluvial deposits. *Soil. Sci. Soc. Amer., Proc.*, vol. 3, pp. 323-329, illus., 1938.

Results of observations relative to the mechanical, chemical, and mineralogical composition of recent alluvium deposited by the Ohio River flood of January and February 1937. Data are given on the chemical composition of colloids from Ohio River flood sediments and from certain soils of the Ohio River basin.

2. (and Hearn, W. E.). Chemical and physical properties of some of the important alluvial soils of the Mississippi drainage basin. *U. S. Dept. Agr., Tech. Bul.* 833, 82 pp., 1942.

Describes the results of a study to determine the chemical and mechanical composition of the more important alluvial soils along the Mississippi River and its main tributaries. Investigation includes a study of material from the channel of the river at its mouth and sedimentary material in the Gulf of Mexico. Mechanical analyses indicate that the greater part of the coarser material is not carried long distances from its source. The chemical analyses indicate that chemical composition of alluvial soils reflects the general differences of the various geologic areas from which they are derived. The chemical composition of soils and colloids of the Mississippi lowlands shows definitely that the major portion of this material is derived from the eastern slopes of the Rocky Mountains and from the Great Plains area.

HOLMQUIST, F. N.

1. Behavior of debris-carrying rivers in flood. *Engin. News-Rec.*, vol. 94, no. 9, pp. 362-365, illus., Feb. 26, 1925.

Describes behavior during flood of the Verde River near Fort McDowell, Ariz., the Salt River near Tempe, Ariz., and the Colorado River near Blythe, Calif. Southwestern rivers are confined to narrow channels which are scoured to great depths during flood with only a small rise of stage. The velocity of water in the channel is much greater than that adjacent to the channel, causing increased sediment load by scour in the channel and deposition adjacent to the channel. As a result the channel becomes deeper and deeper while submerged ground alongside becomes higher. The deepened channel in turn causes still greater velocity, resulting in further scour. This process continues in flood until the channel is bottomed in material which even the highest velocities will not move. The author believes that increased capacity of such rivers can be provided by confining the river to a limited width rather than by allowing it to spread out indefinitely.

HOLT, ERNEST G.

1. Conservation of wildlife. *U. S. Cong. House. Select Com. on Conserv. Wildlife Resources, Hearings*, 75th Cong., 3rd sess., Pursuant to H. Res. 11, pp. 27-38, 1938.

Outlines activities of the U. S. Soil Conservation Service which have a bearing on wildlife conservation. Includes one paragraph on the need for gully control to protect fish from the effect of silt which buries eggs, clogs gills, and destroys food, such as plankton and aquatic vegetation, by occluding light.

HOOKE, ELON H.

1. The suspension of solids in flowing water. *Amer. Soc. Civ. Engin., Trans.*, vol. 36, pp. 239-324, illus., 1896.

Presents a historical review of theories and observations on the suspension, transportation, and deposition of solids by flowing water, and an analysis of the cause of suspension in order to develop a satisfactory theory. Summarizes results of experiments and analyses of observations on laws relative to the phenomena involved in the suspension of solids as developed by Dubuat, Dupuit, Forshay, Humphreys and Abbot, Partiot, Lechalas, Eads, Gilbert, McMath, Thoulet, Du Boys and others. Discusses observed data with particular reference to various factors affecting conditions of transportation and deposition of solids. Minor agents influencing sedimentation, influence of depth and velocity, distribution of sediment in cross-section, velocities at which dragging begins, vertical current velocities necessary for suspension, and other hydraulic facts are reviewed. Examines theories on the causes of suspension and gives conclusions.

Discussion: M. LEAN PARTIOT, p. 326, briefly describes conditions of erosion and sedimentation in the bends of a stream. M. A. FLAMANT, pp. 327-328, comments on Hooker's conclusions that the weight of suspended material per cubic unit of water decreases from rise to embouchure. Discusses in this connection, the influence of the state of bed and banks, character of the material transported, and its transporting velocity. Notes necessity of differentiating between bed and suspended load. WILLIAM STARLING, pp. 328-336, enlarges on the list of authorities listed in Hooker's paper. Extracts from Observations upon the Erosion in the Hydrographic Basin of the Arkansas River, by J. C. Branner (reprinted from the Wilder Quarter Century Book, Ithaca, N. Y., 1893) gives data on suspended load determinations taken at Little Rock during 1887-88. Discusses the relationship between transporting power and velocity, and factors affecting conditions of sediment transportation and deposition. Application is made to Mississippi River data. GEORGE Y. WISNER, pp. 336-338, adds to Hooker's conclusions, relative to the causes of sediment suspension, the factor of the curvature of the river bed. The influence of particle density on its acceleration and the relationship of velocity to transporting power are discussed. L. J. LE CONTE, pp. 338-340, briefly describes Airy's law on the transporting power of flowing water, the ratio of the bed and suspended loads in sedimentary streams, the distribution of sediment in stream cross section, and the effects of viscosity on the transporting power of running water. THE AUTHOR, p. 340, comments on the question of surface convexity and the notes that the principal of scour at the concave bank and deposition in the opposite convex bank has its logical outcome in a longitudinal sinuous movement of the stream bed.

HOOON, R. C.

1. (and Dhawan, C. L.). A study of the fertilizing value of the silts carried in suspension by the rivers of the Punjab. *Indian Jour. Agr. Sci.*, vol. 14, pt. 1, pp. 69-74, illus., Feb. 1944.

Presents a chemical analysis of silts carried in suspension by the various rivers of the Punjab in order to acquire some knowledge of their fertilizing properties. Notes the differences between silts of the various rivers by considering the percentage fractions of the silts that are likely to reach the fields and their calcium carbonate contents. Points out that silts high in calcium carbonate may cause a deterioration of soils and those low in calcium carbonate have no harmful effects. Gives results of mechanical analysis of silts from Punjab rivers.

HOPKINS, C. G.

1. A plea for a scientific basis for the division of soil particles in mechanical analysis. *U. S. Dept. Agr., Div. Chem. Bul.* 56, pp. 64-66, illus., 1899.

Pleas for a scientific basis for the division of particles into sizes. Suggests a true geometric grade scale based on the square root of 10.

2. A rapid method of mechanical soil analysis, including the use of centrifugal force. *U. S. Dept. Agr., Div. Chem. Bul.* 56, pp. 67-68, 1899.

HOPKINS, C. G. - Continued

Describes a method of mechanical analysis which makes use of centrifugal force.

HOPKINS, WILLIAM.

1. On the transport of erratic blocks. Cambridge Phil. Soc., Trans., vol. 8, pt. 2, pp. 220-240, illus., 1844.

Investigates mathematically the transporting powers of currents of water. Compares different modes of transport such as by glaciers, floating ice, and currents. Notes that a body acted on by a current may be moved by sliding or rolling. Considers the force which a current is capable of exerting on bodies of particular forms.

HORATUS, M. DE.

1. Istituzioni di idronomia montana (Laws of mountain hydronomy). 2 vols. Florence, Italy, Di Mariano Ricci, 1930. In Italian. Translation on file at the U. S. Soil Conservation Service, Washington, D. C.

A work on mountain stream control. Considers such subjects as morphology and morphometry of the fluvial bed, laws on fluvial physics, laws on fluvial hydrology, works for controlling mountain streams, and procedures for controlling mountain streams.

HORBERG, LELAND. See Fryxell, F. M., 1.

HORNER, LEONARD.

1. On the quantity of solid matter suspended in the water of the Rhine. Edinburgh New Phil. Jour., vol. 18, pp. 102-106, Oct. 1834-Apr. 1835. Presents results of observations on the quantity of solid matter in suspension in the Rhine River at Bonn. Describes sampling apparatus. Estimates total quantity of suspended material carried by the Rhine River annually, from observations at Bonn.

HORTON, ROBERT E.

1. Watershed leakage in relation to gravity water supplies. New England Water Works Assoc. Jour., vol. 33, no. 3, pp. 306-336, illus., Sept. 1919. Discusses causes of watershed leakage and means for its detection. Illustrations are cited. Discussions briefly consider the effect of silt in preventing reservoir leakage.

2. Density currents in reservoirs and lakes [letter to editor]. Civ. Engin., vol. 9, no. 4, p. 254, Apr. 1939.

Comments on Underflow in Lake Lee, North Carolina (Hough, J. L., 5). Notes that denser inflowing water did not disappear beneath the surface for some distance in the reservoir because inflowing water was turbulent, whereas flow through reservoir was laminar. Distinguishes between flow in lakes formed in river channels and other types of lakes, in both of which the flow is predominately laminar, while on the other hand, the flow in river reaches is predominately turbulent. This accounts for the possibility of existence of density currents and thermal stratification in lakes.

3. Erosional development of streams and their drainage basins; hydrophysical approach to quantitative morphology. Geol. Soc. Amer. Bul., vol. 56, no. 3, pp. 275-370, illus., Mar. 1945.

Notes that the composition of the stream system of a drainage basin can be expressed quantitatively in terms of drainage density, stream order, stream-length ratio, and bifurcation ratio. Comments on two fundamental laws which connect the numbers and lengths of streams of different orders in a drainage basin and the two fundamental concepts upon which the infiltration theory of surface runoff is based. Comments on erosive force and rate of erosion and development of interior divides. Notes that valley and stream development occur together and are closely related. Stream development and drainage-basin topography are considered from the viewpoint of the operation of hydrophysical processes; this concept carries stream development back to the original surface which is newly exposed. Correlates this concept with the Davis erosion cycle which begins after the development of at least a partial stream system.

HOSTETLER, ALICE WATTS.

1. The Canadian willow planter. Amer. Forests and Forest Life, vol. 36, no. 6, pp. 350-352, illus., June 1930.

Describes Scheifele's method of planting white willow as a form of bank revetment to control erosion and lessen silting in rivers. An example of successful planting was one of 65,000 running feet of willow poles along a creek that had deposited silt on the Erie Railroad tracks during floods; another was where erosion had undermined a bridge approach near St. Thomas, Ont. In both cases, the expense of concrete protective construction was saved.

HOUGH, JACK L. See also Connaughton, M. P., 3, 6, 7.

1. The bottom deposits of southern Lake Michigan. Jour. Sedimentary Petrology, vol. 5, no. 2, pp. 57-80, illus., Aug. 1935.

Presents results of field and laboratory observations on the distribution and characteristics of the bottom deposits of southern Lake Michigan. Includes a discussion on field and laboratory methods and describes sampling equipment.

2. (and Flaxman, Elliott M.). Advance report on the sedimentation survey of Black Canyon Reservoir, Emmett, Idaho. U. S. Soil Conserv. Serv., SCS-SS-19, 20 pp., illus., Dec. 1937.

The survey, conducted during the period May 21 to Aug. 13, 1936, at Black Canyon Reservoir, on the Payette River, 5 miles northeast of Emmett, Idaho, revealed that the original 37,659-acre-foot reservoir, which is used for irrigation and power purposes, had lost 10.72 percent of its original capacity since its completion in June 1924, an average annual depletion of 0.89 percent. Total sediment deposited during 12 yr. of operation amounted to 4,037 acre-feet; an average annual accumulation of 336 acre-feet. Detailed data are presented pertaining to the engineering features of the dam and reservoir. Describes the general character of the 2,540-sq. miles of watershed, including geology, topography and drainage, soils, land use, and erosion conditions. Construction by the U. S. Soil Conservation Service of works to protect badly eroding banks of Squaw Creek is noted. Gives data relative to the character, distribution, and origin of sediment in the reservoir; compaction, porosity, and weight of deposited silt; and estimated sediment contribution of the Payette River and Squaw Creek. Sediment in the reservoir is derived chiefly from soil creep on steep slopes of the Payette portion of the watershed and from erosion by surface runoff on cultivated and grazing land of the Squaw River portion of the watershed.

3. (and Flaxman, Elliott M.). Advance report on the sedimentation survey of the Bennett Irrigation and Silting Basin, Wilsoncreek, Washington. U. S. Soil Conserv. Serv., SCS-SS-27, 20 pp., illus., Oct. 1938.

Deals with a survey made August-October 1936 of the Bennett Irrigation and Silting Basin located on Wilsoncreek, 3 miles northeast of the town of Wilsoncreek, Wash. The purpose of the basin is to conserve surface runoff of melting snows and use the transported load of fertile silt for agricultural purposes. The survey was made after the basin had been in operation 19 yr. and during this period an average depth of 1.8 ft. and a maximum depth of 4 ft. of fertile sediment had been deposited in the basin. The area of the watershed is 475 sq. miles of which 55-60 percent is covered with loessial soils devoted to wheat cultivation. Erosion of cultivated slopes had resulted in loss of between 25 and 50 percent of their topsoil in the relatively short period they have been in cultivation. Results of determinations of silt samples indicate that the maximum dry weight per cubic foot of sediment in the basin is 69.8 lbs. and the minimum 65.2 lbs. Pot cultures, using barley and alfalfa as an index, indicated that the relative productivity of the basin sediment is greater than that of either the old valley soil or the water-

- shed soil. The conclusion is reached that this type of project is more desirable than others established in the coulee bottoms for moisture conserving purposes since additional benefits are derived from the accumulation of sediment in the basin.
4. Bottom-sampling apparatus. In Trask, P. D., ed. Recent marine sediments; a symposium, pp. 631-664, illus. London, T. Murby and Co., 1939. Describes various instruments for the sampling of deposited sedimentary material and refers to suspended-load samplers. Sediment traps, for the collection of material settling from suspension, and ripple-mark samplers are described. Applicability of coring tubes for the sampling of fine-grained sediments is discussed; Trask's modified Ekman coring tube, pile driver type of coring tube, Davis peat sampler, Piggot gun and Varney-Redwine hydraulic apparatus, drag buckets or dredges, chambered weights, samplers operated with stiff handles, and grab buckets are described. The adaptability of the apparatus to the sampling of sediments of various grain sizes is discussed, and consideration is given to cost.
 5. Underflow in Lake Lee, North Carolina. Civ. Engin., vol. 9, no. 1, pp. 36-37, illus., Jan. 1939. Notes that highly colored sediment-laden water entered the reservoir following rain of nearly an inch in the watershed. Sediment-laden water extended some distance into the lake before sinking beneath clear water, forming a sharp boundary line on the surface. The temperature difference between clear and muddy water, which was colder, was easily discernible with the hand. Turbid water was discharged at the bottom of the dam, but water flowing over the spillway was clear. The underflow may be due in part to the nature of the sediment which is extremely fine-grained.
 6. The place of sedimentation studies in the Soil Conservation Service. Mines Mag., vol. 30, no. 1, pp. 23-24, 29, 45, illus., Jan. 1940. Briefly describes the work of the Sedimentation Division of the U. S. Soil Conservation Service, including immediate and ultimate objectives of the Reservoir Section, economic and engineering aspects of the reservoir silting problem, the completed work of this section, effects of sedimentation on valley lands and stream channels, function and progress of work of the Stream and Valley Section, and objectives and methods of the Stream Bedload Section. Laboratory investigations at the California Institute of Technology on mechanics of sediment transportation, and sedimentation studies as a phase of flood control program and in the development of special methods and apparatus are discussed.
- HOUK, IVAN E. See also Fortier, S., 2; Grover, N. C., 12; Grunsky, C. E., 5; Rothery, S. L., 4.
1. Making gravel come to the plant. Successful Methods, vol. 5, no. 4, pp. 6-7, illus., Apr. 1923. Briefly describes details of construction of a dam and gravel plant on the Miami at Hamilton, Ohio. The dam forms an artificial settling basin in which gravel, moving downstream during flood periods along the bottom of the stream, is caught. A local gravel company utilizes material from this source.
 2. Placing concrete revetment on river banks. Successful Methods, vol. 5, no. 8, pp. 16-17, illus., Aug. 1923. Describes method of placing concrete revetment for the prevention of river bank erosion in the Miami Conservancy District, chiefly at Hamilton and Dayton, Ohio.
 3. Sand-control works at Fort Laramie Canal Intake. Engin. News-Rec., vol. 100, no. 24, pp. 922-926, illus., June 14, 1928. On design, construction, operation, and necessity for silt control works at the Fort Laramie Canal Intake at Whalen Diversion Dam, North Platte irrigation project in eastern Wyoming and western Nebraska. The works consist of settling basin, skimming weir, and sluiceway. About three 45-min. sluicings per week are required to keep canal waters clear of sand. Costs of construction are included in detail.
 4. Sand problems at Franklin Canal Intake, Rio Grande project. West. Construct. News, vol. 3, no. 22, pp. 712-718, illus., Nov. 25, 1928. Describes the design and efficiency of various works constructed to remove sand and silt from the canal system. The effect of Elephant Butte Dam upon conditions of erosion and deposition below the dam is briefly considered.
 5. Mead Lake temperature measurements. Reclam. Era, vol. 27, no. 9, pp. 216-217, illus., Sept. 1937. Describes the measurement of temperature by an electrical resistance thermometer at different levels in Lake Mead. Temperature conditions are transient until the reservoir fills up. On May 21, 1937, abnormally warm water near the bottom of the lake was primarily due to a very heavy silt load having the color and consistency of thick chocolate and a specific gravity of 1.1787 (74-78°F.), while clear water above this strata had 1.0014 (74-78°F.). A small part of the increased specific gravity of the silty water may have been due to increased salt content by solution of salt from a formation in Virgin Valley or to the flow of alkaline springs. Increased temperature of the bottom strata may also have been due to warm springs, but it is believed to have been due primarily to the stratification of silty water along the bottom of the canyon.
- HOULTAIN, H. E. T. See also Buckham, A. F., 1.
1. Splitting the minus-200 with the Superpanner and Infrasizer. Canad. Inst. Mining and Metall., Trans., vol. 40, pp. 229-240, 1937. Presents information, on the analysis of fine-grained sediments and notes the development of the Superpanner for separating fine auriferous particles in gold ones from Kirkland Lake, Ontario. The Infrasizer was developed for size analysis of fine material and can separate large amounts of minus-200 mesh material into any desired number of grades. It is essentially an air elutriator.
- HOVERS, J. See Pieters, H. A. J., 1.
- HOWARD, A. D. See Coker, R. E., 1.
- HOWARD, ARTHUR D.
1. A simple device for the manipulation of individual detrital grains of minute size. Jour. Sedimentary Petrology, vol. 2, no. 3, pp. 160-161, illus., Dec. 1932. Describes a device for manipulating individual detrital grains of minute size.
- HOWARD, CHARLES S. See also Collins, W. D., 2, 3, 4, 5, 9; Grover, N. C., 12; Grunsky, C. E., 5; Larsen, H. T., 1; Love, S. K., 4; Stevens, J. C., 6.
1. Quality of water of the Colorado River in 1926-1928. U. S. Geol. Survey, Water-Supply Paper 636-A, pp. 1-14, illus., 1930. Gives analyses representing composites of samples of Colorado River water collected daily at Grand Canyon, Topock, and Yuma, Ariz., and on tributaries of the Colorado River. Describes methods of analysis. Includes table showing chloride content of daily samples of Colorado River water near Grand Canyon, Ariz., for year ending Sept. 30, 1927. Details processes employed to determine mineral contents of waters and gives data for Colorado River for 1926 and 1927. Discusses agricultural, domestic and industrial usefulness of Colorado water. Gives table of water-sample analyses from Colorado River and certain tributaries, showing in parts per million the amount of suspended and dissolved matter.
 2. Suspended matter in the Colorado River in 1925-1928. U. S. Geol. Survey, Water-Supply Paper 636-B, pp. 15-44, illus., 1930; [abstract], Wash. Acad. Sci. Jour., vol. 20, no. 2, p. 30, Jan. 18, 1930. Presents results of suspended-load determinations of Colorado River water samples taken at Grand Canyon, Topock, and Yuma (1925-28). Describes collection of samples, methods of sampling, and sampling apparatus; suspended-load determinations; and variations in suspended-load discharge. Gives results of previous investigations by U. S. Bureau of Reclamation and U. S. Bureau of Public Roads. Discusses bed-load determinations, estimated volume which suspended material will occupy

- in a reservoir, volume-weight relationship of deposited silt, and effect of pressure and of alternate drying and wetting on volume of deposits.
3. (and Love, S. K.). Observations on suspended matter in the San Juan River. *Engin. News-Rec.*, vol. 105, no. 16, pp. 620-621, illus., Oct. 16, 1930.
Reports observations at the Goodridge gaging station 25 miles below Bluss, Utah, by the U. S. Geological Survey. Describes course of the San Juan River, and methods of measurement. The quantity of suspended matter appears to be independent of velocity or discharge but is governed by supply and nature of material. Includes tabulation of percent suspended matter by weight and discharge in second-feet. Suspended matter varies from 0.25 to 40.8 percent.
4. Quality of water of the Colorado River in 1928-1930. U. S. Geol. Survey, Water-Supply Paper 638-D, pp. 145-158, illus., 1932.
Reports results of analyses, relative to dissolved and suspended load determinations, of samples collected at various points on the Colorado and its main tributaries, the Green, San Juan, and Williams Rivers (1928-30). Notes that the weighted average load of suspended matter carried past Grand Canyon station in 1926, was 225,000,000 tons while the sums of the daily loads for each succeeding year were 396,000,000, 172,000,000, 480,000,000 and 236,000,000 tons respectively.
5. Suspended matter in the Colorado River, 1925-1935. *Amer. Geophys. Union, Trans.*, vol. 17, pt. 2, pp. 446-447, illus., July 1936.
Gives summary of data on discharge and suspended matter for the Colorado River at Grand Canyon gaging station. Describes topography of the Colorado River basin. Gives comparison of the water and silt discharge of Green, San Juan, and Little Colorado Rivers noting that the Little Colorado River, during the summer of 1931, carried 10,000,000 tons of suspended matter, and the Colorado River during the same period had about 25,000,000 tons. States that suspended matter in the Colorado River, as in other turbid rivers, varies from period to period, but there is no direct relation between load of suspended matter and discharge of river. The nature of suspended matter shows considerable variation during a year, particularly in size of particles transported. Deposited material along the banks and bed of the Colorado River weighs 85 lbs. per cu. ft. and this weight has been used in computations on volume of reservoir deposits. Estimated volume of material deposited in Lake Mead from Feb. 1 to Sept. 20, 1935 was about 55,000 acre-feet, and during the same period 8,000 acre-feet of material was scoured out of the Colorado River below Boulder Dam and carried past Topock, Ariz. Graph gives annual loads of suspended matter at Grand Canyon gaging station for a period of 10 yr. The average annual load, based on a 10-yr. study by the U. S. Geological Survey, is about 250,000,000 tons. On the basis of 85 lbs. per cu. ft. this would occupy 140,000 acre-feet of storage space in the reservoir.
6. Transportation of mineral matter by surface water. In *Physics of the earth*, vol. 9, *Hydrology*, pp. 637-645. New York, McGraw-Hill Book Co., Inc., 1942.
Discusses the mineral matter carried in solution and suspension in streams. Treats methods of sampling of suspended matter, sizes of material in suspension, and loads of suspended matter in various streams.
7. Suspended sediment in the Colorado River, 1925-41. U. S. Geol. Survey, Water-Supply Paper 998, 165 pp., illus., 1947.
Gives the results of sediment-sampling studies of the Geological Survey in the Colorado River basin, Oct. 1, 1925-Sept. 30, 1941. Includes records for the entire period for the Grand Canyon gaging station and for shorter periods for other stations in the basin. Results consist of records of mean daily concentrations of sediment for all stations and the mean daily discharge and daily load of sediment for many of the stations. Gives information concerning size of particles at the Grand Canyon, Willow Beach, and Bluff stations.
8. Laboratory experiences with the bottom withdrawal tube method of size analysis. *Fed. Inter-Agency Sedimentation Conf.*, Denver, 1947, *Proc.*, pp. 235-243, illus., 1948.
Discusses the laboratory experiences and techniques used with the bottom withdrawal tube method of size analysis. This method was used at the Southwestern Laboratory of the U. S. Geological Survey for nearly three years for analyzing 1000 samples. Various methods of plotting analytical data are given.
Discussion: MARTIN E. NELSON, pp. 243-244, comments on problems such as flocculation which is encountered with use of the method of the bottom withdrawal tube. Notes that the bottom withdrawal tube method is not the ideal instrument, but is superior to other methods. E. W. LANE, pp. 244-245, points out that it is often impossible to tell at the time the analysis is made, of what use the data will be at a future date. In some situations more than one method would be indicated by the probable uses of data. These problems are illustrated by two main classes of cases. BILLY T. MITCHELL, p. 245, comments on the use of the bottom withdrawal tube in the Omaha District. Believes it is the most satisfactory instrument we have at present for determining particle size.

HOWARD, D. S.

1. The overflow of the Mississippi River. *Franklin Inst. Jour.*, vol. 92, no. 4, pp. 253-256, Oct. 1871.
Discusses the inapplicability of the levee system in the lower Mississippi River as a means of preventing overflow during floods, and proposes a system of reservoirs at or near headwaters of the river and its tributaries to prevent floods. Compares effects of reservoir and levee systems, noting in particular the relative conditions of the transportation and deposition of sediment.
2. The overflow of the Mississippi River. *Franklin Inst. Jour.*, vol. 94, no. 5, pp. 334-336, Nov. 1872.
Discusses advantages and disadvantages of the levee, outlet, and reservoir systems for control of overflows in the lower Mississippi River. The effect of the outlet system on the bars at the mouth of the river and conditions of transportation and deposition of sediment in outlets are noted.

HOWARD, G. W. See also Griffith, W. M., 2; Matthes, G. H., 4.

1. Transportation of sand and gravel in a four-inch pipe. *Amer. Soc. Civ. Engin., Trans.*, vol. 104, pp. 1334-1348, illus., 1939; also in *Amer. Soc. Civ. Engin., Proc.*, vol. 64, no. 7, pp. 1377-1391, illus., Sept. 1938.
Gives results of tests to determine the flow characteristics of water mixed with sand and small gravel of varying concentrations in a four-inch pipe, and reports applicability of findings to other sizes of pipes. Cites existing formulas for the transportation of material in pipe lines. States facts relative to phenomena involved in the transportation of sand and water mixtures. Reports program of experiments and apparatus for solid concentration determinations, giving procedure of experimentation. Describes type of transportation for sand and water and for gravel and water mixtures in pipes. Notes changes in head loss for mixtures in four-inch pipe and in curves. Gives common formula for head loss; and an exponential formula for pipes carrying sand. Economical velocity of sand transportation, and applicability of results of experiments to larger pipes used in dredging are discussed.
Discussion: FRED R. BROWN, pp. 1349-1350, gives data showing that friction factor in pipes transporting material increases with percentage of material and decreases with velocity, thus bearing out Howard's findings. Notes necessity of using volumetric method to determine velocities and percentages of solids in order to secure accurate data as basis for formula governing transportation of material in pipes. JOSEF E. MONTGOMERY, pp. 1350-1351, considers causes of variations of friction factor f , with velocity for flow in four-inch pipe carrying water mixed with sand or gravel.

Changes indicate possible existence of motionless solids on bottom of pipe and consequent waste of energy. ELLIOTT J. DENT, pp. 1351-1357, presents data showing blocking-off points for some mixtures in sand tests in a four-inch pipe. Discusses the Chezy formula for loss of head; formula for computing friction due to flow of water in pipe lines; determination of loss of head due to a given velocity; and friction losses due to flow at various concentrations, for different kinds of materials, and at various velocities in four-inch pipe. Gives application to practical dredging operations. DAVID L. NEUMAN, pp. 1357-1359, criticizes Howard's use of the "economical velocity" in dredging operations. Notes use of gages to record discharge velocities and percentage of solids passing through discharge line employed in connection with dredging operations. MORROUGH P. O'BRIEN, and R. G. FOLSOM, pp. 1359-1362, gives conclusions drawn by writers based on results of experiments on the transportation of sand in pipe lines (O'Brien, M. P., 5) conflict with the conclusions arrived at by Howard. Writers discuss, in this connection, the critical velocity in a pipe and the effect of velocity changes on head loss. Comments upon the importance of the settling velocity of the material transported as a factor in the distribution of sand concentrations. R. L. VAUGHN, pp. 1362-1369, states that apparent percentage of solids and weight and gradation of particles in pumpable mixture are factors to be considered in dredging operations. Considers the conditions for the maintenance of constant concentrations for materials in pipes. Comments further on other factors relative to the flow of mixtures along the bottom of a pipe. Discusses experimental tests by O'Brien and Folsom on the transportation of sands in pipes. Economical velocity for a dredger is considered. M. P. DUREPAIRE, pp. 1369-1372, summarizes the results of laboratory experiments in France on sand transportation in dredge pipes. Makes further comment on the economical velocity in pipes, jerking and plugging, and pump and suction head efficiency. PIERRE F. DANIEL, pp. 1372-1374, notes that laws governing transportation of sediment in pipes have much in common with those of open channels. Compares concentration distributions for conditions in open channels and those in pipes. Briefly makes further analogies. H. S. GLADFELTER, pp. 1374-1376, describes tests by writer in 32-in. pipe line dredges on the carrying capacity of several types of pipe lines. Comments on Howard's "economical velocity." THE AUTHOR, pp. 1376-1380, emphasizes investigation by writer concerning methods for increasing the capacity of pipe lines transporting solids. Comments on other discussions of paper.

HOWE, ERNEST.

1. Landslides of the San Juan Mountains, Colorado. U. S. Geol. Survey, Prof. Paper 67, 58 pp., illus., 1909.

Consists of a study of landslides and rock streams in the San Juan Mountains, Colo. Considers the classification of landslides and their causes. Treats of the cause of and classification of landslides in the San Juan Mountains. Describes the Slumgullion mudflow and includes a photograph of this flow.

HOWELL, LYNN G. See Johnston, N., 1.

HOWELL, R. P.

1. Keeping the Mississippi within bounds. Military Engin., vol. 16, no. 88, pp. 283-291, illus., July/Aug. 1924.

Describes the Mississippi River and its Delta and discusses the levee problem. Describes the use of willow mattress and other progress in levee construction. Includes a paragraph on the process of bank erosion and bar formation, and a method of transportation and sorting of sediment.

HOYT, W. G.

1. (and Troxell, H. C.). Forests and stream flow. Amer. Soc. Civ. Engin. Trans., vol. 99, pp. 1-30, illus., 1934.

Discusses the effects of change in vegetable cover on stream flow characteristics. Reports experiments made by U. S. Forest Service and U. S. Weather Bureau, 1910-26, on two contiguous tracts of land in southern Colorado. Stream flow measurements were made by U. S. Geological Survey on certain areas in California. Detailed observations in above areas for several years prior to and after changes in cover by cutting and by fire are given. No evidence of erosion in Wagonwheel Gap area after deforestation due to the lack of direct surface runoff. Increased erosion as the result of denudation and increased runoff characterized conditions in the Fish Creek basin, southern California, as evidenced by the increased silt content of Rogers, Fish, and Sawpit Creek. Notes that deposition of eroded material in Fish Creek basin materially injured agricultural lands and transportation rights of way below the canyon.

Discussion: C. G. BATES, pp. 31-36, comments upon conclusion by Hoyt and Troxell regarding the beneficial effects of denudation to increased water supplies. Notes reservoir difficulties occasioned by silt-laden surface runoff.

GEORGE H. CECIL, pp. 63-64, takes exception to deductions by Hoyt and Troxell relative to their proposed method of increasing summer flow by destruction of watershed cover. States that silt production due to repeated burning decreases percolation into underground reservoirs, causing excessive damage, and necessitates bypassing of major portion of silt-laden flow to the sea. C. W. SOPP, pp. 66-68, considers the undesirability of proposal by Hoyt and Troxell of utilizing maximum runoff from denuded watersheds. Notes impossibility of diverting silt-laden flood flows, the effect of silt-laden waters on percolation, the difficulties encountered at canal headworks due to excessive silt in waters, and the problem of reservoir silting. Cites loss of storage space in reservoirs of southern California due to accumulations of erosional debris resulting from denudation by fire on watersheds. HERMAN STABLER, pp. 80-86, corroborates conclusions of Hoyt and Troxell by presenting conditions of experiments and results of study by C. L. Forsling to determine the effect of vegetation on runoff and erosion in relation to grazing on the Wasatch Plateau, Utah. Data on precipitation, runoff, and sediment accumulations are given. H. S. GILMAN, pp. 86-94, takes exception to attempt by Hoyt and Troxell to show that denudation increases water and production yields. States that increased silt content in waters affect percolation and is objectionable for irrigation and domestic use. Notes possible effect of increases in debris content of streams due to denudation upon the economic life of reservoirs in southern California. THE AUTHORS, pp. 94-111, review previous discussions. Authors take exception to statement that increased runoff made available by deforestation is destructive since suspended matter content of streams is increased, thereby affecting percolation to underground reservoirs, showing that muddy water can be and is passed into ground water.

2. Erosion and watershed protection. Civ. Engin., vol. 4, no. 2, pp. 81-84, illus., Feb. 1934.

Divides the watersheds of the country according to their erosion characteristics into four general types. Outlines changing conditions and describes remedial measures which are taken to provide stability. The part played by the engineer is noted.

HSIA, CHEN-HUAN. See also Kalinske, A. A., 11.

1. A study of the transportation of fine sediment by flowing water. July 1943. Thesis (M. S.) - State University of Iowa; [abstract], Iowa Univ., Studies in Engin. Bul. 33, pp. 57-58, 1949.

Investigates the transportation of fine sizes and high concentrations of suspended sediment. Gives attention to the relation between bed composition and quantity of suspended material.

HSIEH, C. T.

1. (and Lu, A., and Yeh, Y. N.). Hydrology of the Yellow River. Studies on Yellow River Proj. Pub. 4, 136 pp., illus., June 1947.
Includes a compilation of all available hydrological data on the Yellow River basin, China. The chapter on silt reviews soil erosion in the basin, silt flow in streams, annual silt flow in the lower course of the Yellow River, and the silt-concentration problem. Gives data on the silt load of the Yellow River. In the chapter on basin and channel characteristics, deposition of silt and scouring of channel bed are considered.

HSU SHIH-TA.

1. (and Li Shu-tien). The radical improvement scheme for the Yung Ting Ho. Assoc. Chinese and Amer. Engin. Jour., vol. 15, no. 2, pp. 22-34, Mar./Apr. 1934.

Describes proposed methods of regulating flood flow and preventing breaches of the Yung Ting Ho, and of ameliorating the silting of the Hai Ho. Gives estimated silt discharge to both rivers.

2. (and Li Shu-tien). The radical improvement scheme for the Yung Ting Ho. Assoc. Chinese and Amer. Engin. Jour., vol. 15, no. 3, pp. 12-25, illus., May/June 1934.

Gives details of construction and costs for the proposed improvement. Includes discussion on the anticipated use of silt-depositing districts to dispose of silt and to improve adjacent land. Among other benefits to be derived from the scheme, the silting of the Hai Ho would be controlled.

HUANG, W. H. See also Chang, Y. L., 1.

1. Water and soil conservation of the Yellow River basin. Studies on Yellow River Proj. Pub. 5, 47 pp., illus., June 1947.

Deals with problems concerned with soil erosion and water conservation of the Yellow River basin, China. Considers briefly the scarcity of reservoir sites in the Yellow River basin and the importance of silt deposits in the reservoirs and of the task of minimizing the effects.

HUBBARD, CLYDE W. See Kalinske, A. A., 2.

HUBBARD, GEORGE D.

1. The relation of gold and silver mining to the development of associated industries. Geog. Soc. Phila. Bul., vol. 9, no. 1, pp. 1-22, Jan. 1911.
Shows the interrelation of gold and silver mining and other industries in the United States. Includes discussion (pp. 12-15) on the deleterious effect of mining operations upon agriculture caused by the washing away of the land by hydraulic mining methods and the filling of the streams with mining debris.

HUBBARD, PREVOST. See Cushman, A. S., 1.

HUBBEL, GEORGE E.

1. Grit chamber model tests for Detroit, Michigan, sewage treatment project. Amer. Soc. Civ. Engin., Proc., vol. 63, pp. 1867-1882, illus., 1937.

Presents results of model studies conducted to solve some of the problems of design of the grit chambers for the Sewage Treatment Plant, Detroit, Mich. A small-scale model is used to observe flow distribution and grease removal. Large-scale tests of two existing tanks to determine the percentage removal of sand of various sieve sizes for any given length of tank are given. Presents actual data on the settling of sand in flowing water under field conditions.

HUBBELL, D. S. See also Gardner, J. L., 1.

1. (and Gardner, J. L., and Sherman, G. L.). Progress report of the Navajo Soil and Water Conservation Station, Mexican Springs, New Mexico, 1934-1939. U. S. Soil Conserv. Serv., SCS-ESR-9, 52 pp. and appendix, illus., Mar. 1941.

Describes investigations and studies by the Navajo Soil and Water Conservation Station, Mexican Springs, N. Mex., 1934-39. Notes study of vegetation and soils as they are affected by successive floodings on farm and range land. Considers study of source, quality, and quantity of runoff water and eroded material from small plots and from entire drainage area. Gives procedure and results. Includes data on silt in the area; a Yuma sampler was used to obtain data on silt measurements of runoff.

HUBBS, CARL L.

1. (and Greeley, John R., and Tarzwell, Clarence M.). Methods for the improvement of Michigan trout streams. Mich. Univ. Inst. for Fisheries Res., Bul. no. 1, 54 pp., illus., Aug. 30, 1932.

Describes methods of improving streams in Michigan for the propagation and protection of the trout supply. Includes discussion on various types of river improvement for the prevention and removal of silt deposits in streams and for the deposition of rich food-producing silt.

HUDSON, H. E.

1. Problem of reservoir siltation. Amer. Water Works Assoc. Jour., vol. 41, no. 10, pp. 913-915, Oct. 1949.

Discusses the general aspects of reservoir siltation. Considers the Illinois survey program and factors pertaining to reservoir sedimentation brought out by the surveys. Notes the effect of watershed size and land use.

HUGHES, D. E.

1. Amount of silt that would be deposited in a reservoir at San Carlos. 63d Cong., 2d sess., H. Doc. 791, pp. 117-140, illus., 1914.

Discusses various factors concerned with determining the amount of silt which would be deposited in a reservoir at San Carlos, Ariz. Gives tables showing the weight of the Gila River silt deposits and indicated volumetric percentage of mud after settling. Includes data on the monthly percentages of soil carried in suspension by the Rio Grande at San Marcial, 1897-1912; shows data on silt observations at the Buttes in 1895, 1899-1900; has tables showing sediment observations at San Carlos for 1901, 1902, 1904, and 1905. Gives a summary of silt data for the Gila River.

HUGHES, J. See Wallace, R., 1.

HULL, WILLIAM X.

1. A special problem in soil conservation. Agr. Engin., vol. 19, no. 11, pp. 505-506, Nov. 1937.

On the control of side washes which cut deep arroyos in southwestern cattle ranges. These are controlled by building earth dams with weep holes to spread the excess water over range land below and allow it to be dissipated by percolation or to enter the arroyo below the dam at low velocity. Spur dikes and detention dams are used on water courses closer to mountain slopes.

HUMPHREY, J. S.

1. Irrigation in Kansas. Ohio Soc. Civ. Engin. and Surveyors, Ann. Rpt. 9, pp. 156-161, 1888.

Discusses the development of irrigation practice in Kansas and describes several of the irrigation ditches in the State. Briefly comments upon the problem of silting in the irrigation ditches.

HUMPHREYS, A. A.

- 1 (and Abbot, H. L.). Report upon the physics and hydraulics of the Mississippi River. 456 pp. Philadelphia, Lippincott, 1861. Reprinted with additions as U. S. Engin. Dept., Prof. Paper 13, 490 pp., illus., 1876; [abstract], Amer. Jour. Sci. (ser. 2) vol. 33, no. 98, pp. 181-189, Mar. 1862.

Presents results of a detailed survey on the physics and hydraulics of the Mississippi River. Describes the Mississippi basin as to topography, slopes, etc. Gives results of sediment determinations in Mississippi water at Carrollton (1851-52) and in the Columbus (1858), and compares them with those of other observers; measurements upon European and other rivers; and early experiments on bed-load movement. Outlines the history of river hydraulics methods, formulae, etc., employed in gauging rivers. Describes the method of gauging the Mississippi; experimental theories of water in motion; protection against Mississippi floods; analysis of plans with consideration given to condition of sediment transportation and deposition; proposed flood protection works; character and geology of the delta of the Mississippi River; mouths of the Mississippi River; observations on the mouths' bar formation, including mud lumps; and plans for increasing depth on the bars. Appendices present reports by various observers on a survey of the mouths of the Mississippi; proposed improve-

ment of the entrance to the river; observations on the character of alluvion brought down by the river; gauge registers; stream cross-sections; current measurements; discharge measurements; examinations of specimens of borings from New Orleans artesian wells and their bearing on the geological age of the delta; a plan to reclaim the waste swamps of the lower Mississippi basin by a system of diking, utilizing the delta-making material of the water of the river; a shoaling in the Mississippi River at the head of the passes; improvement of the mouths of the river; and improvement of the entrance to the river by jetties.

HUNT, T. STERRY.

1. The deposition of clays. Boston Soc. Nat. Hist., Proc., vol. 16, pp. 302-304, Feb. 18, 1874.
Offers an explanation for the rapid precipitation of suspended clays when in contact with saline solutions.

HUNTER, J. FRED.

1. Erosion and sedimentation in Chesapeake Bay around the mouth of Choptank River. U. S. Geol. Survey, Prof. Paper 90-B, pp. 7-15, illus., 1914.
Presents results of a study of local rates of erosion and sedimentation on the eastern shore of Chesapeake Bay around the mouth of the Choptank River. Briefly outlines the history of topographic, hydrographic and geologic surveys in the area considered and its principal topographic and geologic features. Discusses conditions of erosion and sedimentation resulting in shore line changes which have taken place chiefly on shores exposed to wave action; the points affected by river currents which show less erosion, although in a few places cutting has been equally great. Shows that nowhere has considerable gain been made by the processes of land building. Approximately 34 percent of the area covered by water in the territory under discussion has been affected by erosion or sedimentation and of this portion 80 percent is subject to scouring and 20 percent shows shoaling (1848-1900). No estimates of silt transported through this area from points beyond its borders are given, thus making data on land waste or denudation in the tributary areas unavailable.

HUNTSMAN, BENJAMIN WILLIAMS.

1. The Salonika Plain reclamation works. Inst. Civ. Engin. Jour., vol. 5, no. 5, pp. 243-286, illus., Mar. 1937.
Presents data on details of construction of drainage, flood protection and river regulation works within the Salonika Plain, Greece. Includes brief discussions on the silt problem involved in the construction of the various works and briefly describes measures instituted to prevent silt from entering the new channels.
Discussion: THE AUTHOR, (Inst. Civ. Engin. Jour., vol. 6, no. 8, pp. 430-437, illus., Oct. 1937), comments on previous discussions relative to the capacity of river regulation works in the Salonika Plain for the prevention of silting in the improved channels.

HURSH, C. R. See Sharpe, C. F. S., 3.

HURST, H. E. See also Buckley, A. B., 1; Anonymous, 118.

1. The suspension of sand in water. Roy. Soc., London, Proc., vol. 124, pp. 196-201, illus., 1929.
Results of experiments to find laws governing the suspension of large particles in water. Describes apparatus and method of experimentation.
2. The Sudd Region of the Nile [extract]. Engineer [London], vol. 155, p. 586, June 9, 1933.
Describes proposed projects for water conservation in the Sudd Region of the Nile. Existing and proposed irrigation projects on the lower Nile with particular reference to the silt problem are described.
3. (and Phillips, P.). The Nile Basin—the hydrology of the Lake Plateau and Bahr El Jebel, vol. 5. Egypt Min. Pub. Works, Phys. Dept. Paper 35, 251 pp., illus., 1938.
A report which summarizes and discusses hydrological material collected during the last 30 yr. by the Sudan Branch of the Egyptian Irrigation Service and Physical Department. Con-

siders silt in the Nile, and gives a plate showing suspended solids and discharge at Wadi Halfa during August-November 1931.

HURTZIG, A. C.

1. The River Humber [abstract]. Van Nostrand's Engin. Mag., vol. 32, no. 5, pp. 435-436, May 1885.

Describes the features of the Humber River, England. Notes that scouring action in the estuary of the Humber is so powerful that, in spite of 1,000,000 tons of mud being thrown into the river every year, no ill effects have been observed. Source of the silt is considered.

HUSBAND, J. W.

1. Algal growth and water supply. Water and Water Engin., vol. 35, no. 427, pp. 765-780, Dec. 1933.
Discusses the proposals, treatment, and results of treatment of the water supply of the River Ouse to eliminate the excessive amount of silt passing on to filters of water-supply works and to institute a satisfactory aeration of the supply. Conditions of abnormal fouling of filters by fine silt are described. Notes briefly results of investigations relative to the river silt in suspension in the Ouse water.

HUTTON, C. H.

1. Report on utilization of silt in Italy [abstract]. All-India Sanit. Conf., Lucknow, Proc. 3, pp. 22-23, 1914.
Report on the engineering and agricultural aspects of silt utilization in Italy and their applicability to India.

HUTTON, M. L.

1. Upstream reservoirs. Amer. Wildlife, vol. 26, no. 3, pp. 39, 46-48, illus., May/June 1937.
Discusses the value of small lakes and ponds, both natural and artificial, at headwaters of streams. Defines upstream reservoirs. Discusses natural and man-made forces affecting land-surface reduction, and extent of natural surface lakes at headwaters of streams in Iowa. Acreage of natural upstream reservoirs is lost mostly by drainage. Reduction in capacity is due to silt deposits, bank caving, and accumulations of wind-blown material and decaying vegetation. Gives a plan for improving natural lakes by dredging, bank protection, etc. Lowhead dams are constructed by the Iowa Conservation Commission to impound the water of small streams. Includes a letter from R. W. Oberlin, U. S. Soil Conservation Service, relative to the value and effectiveness of farm ponds. Describes underground reservoirs, and the value of headwater reservoirs in conserving surface water, adding to underground water-supply, soil conservation, providing wildlife environment, etc.

HUTTON, WILLIAM R. See Craighill, W. P., 1; Wisner, G. Y., 1.

HYATT, EDWARD.

1. Variation and control of salinity in Sacramento-San Joaquin Delta and Upper San Francisco Bay. Calif. Dept. Pub. Works, Div. Water Resources Bul. 27, 432 pp., illus., 1931.
Presents results of an investigation in 1929 of salinity in the Sacramento-San Joaquin Delta and in the San Francisco Bay. Includes brief discussion on the effect of hydraulic mining and silting upon salinity conditions in the upper bay and in delta channels during recent years.

ILLINOIS, DEPT. OF PUBLIC WORKS AND BUILDINGS. DIVISION OF WATERWAYS.

1. Report on Kaskaskia River Valley. Ill. Dept. Pub. Works and Buildings, Div. Waterways Bul. 22, 70 pp., illus., 1910-11.
Reports plans for reclamation of lands subject to overflow in the Kaskaskia River Valley, Ill. Contains two paragraphs (p. 48) noting the need of a sedimentation area for the control of excess sediment and drift during flood and the productivity of such areas when reverted to farming.

INDIA, BOARD OF AGRICULTURE AND ANIMAL HUSBANDRY. COMMITTEE ON SOIL AMELIORATION.

1. Report. India Bd. Agr. and Anim. Husb., Crops and Soils Wing, Proc. 1st Meeting, pp. 25-30, 1936.
Presents recommendations for the prevention of the extension of ravine areas and for the amelioration of existing ravine conditions in

INDIA, BOARD OF AGRICULTURE. - Continued

India. Includes one paragraph discussing the effect of river silt on soils.

INDIA, CENTRAL BOARD OF IRRIGATION.

1. Regulation of headworks to exclude silt. India Cent. Bd. Irrig. Pub. 1, pp. 23-29, 1931.

Presents the views of various authorities in India relative to the positioning, design, and regulation of headworks of canals to exclude silt.

2. [Correspondence regarding "tortuosity of rivers"]. India Cent. Bd. Irrig. Pub. 11, pp. 32-38, 1936.

Correspondence in answer to request by the Central Board of Irrigation for information regarding the causes of tortuosity in rivers and the effects of discharge regulation works, cut-offs, weirs and bridges, variations in silt burden of stream, and draw-offs for irrigation, upon conditions of tortuosity.

3. Notes on waterlogging and land reclamation in the form of a questionnaire. India Cent. Bd. Irrig. Pub. 17, 41 pp., illus., 1938.

Answers by various irrigation investigators in India to questions submitted by the Central Board of Irrigation relative to the various factors involved in waterlogging and land reclamation. Includes discussion on the effects of the quantity and quality of silt carried by canal waters on the fertility of soils irrigated by those waters.

INDIA, CENTRAL BOARD OF IRRIGATION. DEVELOPMENT AND RESEARCH DIVISION, KARACHI.

1. Summary of work done during 1935-36. India Cent. Bd. Irrig. Pub. 14, pp. 23-26, 1937.

Briefly summarizes the work accomplished by the Development and Research Division of the Central Board of Irrigation during 1935-36. Gives results of observations on the application of Lacey's relationships to data for seven regime sites on the Jamrao Canal. Reports non-silting channel observations on the Jamrao and gives mechanical analyses of samples of bed and suspended silt collected from various discharge observation sites.

INDIA, CENTRAL BOARD OF IRRIGATION. DEVELOPMENT AND RESEARCH DIVISION, SIND.

1. [Summary of annual report for 1941-42]. India Cent. Bd. Irrig. Pub. 29, pp. 23-34, illus., 1943.

Discusses various formulas and problems, and model experiments conducted during the year. Compares Binkley and bottle silt samplers. Discusses values of Kutter's, Lacey's and Manning's "N."

2. [Summary of annual report, 1942-43]. India Cent. Bd. Irrig. Pub. 31, pp. 24-30, 1944.

Discusses model experiments, design of channels in alluvium, and silt survey of channels. Includes a note on an improved type of bottle silt sampler, and various other projects worked on.

INDIA, CENTRAL BOARD OF IRRIGATION. IRRIGATION RESEARCH DIVISION, POONA.

1. Summary of hydrodynamic research work (1935-36). India Cent. Bd. Irrig. Pub. 14, pp. 7-18, illus., 1937.

A report summarizing results of various model studies conducted by the Irrigation Research Division of the Central Board of Irrigation, India, during 1935-36. Describes experiments with a model of the Ganges River and the Hardinge Bridge on the Eastern Bengal Railway to determine the effects of guide and protection banks upon conditions of flow, scour, and silting. The results of model studies on silt exclusion from canals of the Mara River at Mithras, and results of an experiment with a silt abrader to ascertain whether or not silt becomes appreciably finer under continuous movement and mutual abrasion.

2. [Summary of annual report for 1942-43]. India Cent. Bd. Irrig. Pub. 31, pp. 31-35, 1944.

Describes work in connection with surveys, preparation of projects, and working plans of drainage schemes for the improvement of waterlogged lands in Bombay Deccan. Silting in various reservoirs is discussed.

INDIA, CENTRAL IRRIGATION AND HYDRODYNAMIC RESEARCH STATION, POONA.

1. [Summary of annual report for 1941-42]. India Cent. Bd. Irrig. Pub. 29, pp. 6-21, illus., 1943.

Summarizes briefly the work accomplished by the Central Irrigation and Hydrodynamic Station, Poona, during the year 1941-42. Models were used in various experiments.

2. [Summary of annual report for 1942-43]. India Cent. Bd. Irrig. Pub. 31, pp. 5-22, illus., 1944.

Summarizes briefly the work completed by the Central Irrigation and Hydrodynamic Research Station, Poona, during the year 1942-43. Describes problems dealt with, experiments, and model studies. Studies on river training and scour are included.

INDIA, LAKE FIRE HYDRODYNAMIC RESEARCH STATION, KHADAKAVASLA.

1. Summary of the annual note on experiments carried out during 1936-37. India Cent. Bd. Irrig. Pub. 16, pp. 15-34, illus., 1938.

Includes discussions on model experiments to determine effective means of preventing conditions of scour in the Sina River, District Ahmednagar, Bombay Presidency, on experiments with a silt abrader, and on bed silt of canals.

INDIA, UNITED PROVINCES IRRIGATION RESEARCH AND EXPERIMENT STATION, LUCKNOW.

1. [Summary of annual report for 1941-42]. India Cent. Bd. Irrig. Pub. 29, pp. 37-43, 1943.

Describes model experiments, silt investigations and other problems.

INDRI, EGIDIO.

1. Sulla forza di trascinamento delle correnti liquide (Transporting forces of liquid current). Energia Elettrica, vol. 11, no. 12, pp. 988-998, Dec. 1934; [abstract in English], Civ. Engin., vol. 5, no. 5, p. 12, May 1935. In Italian. Translation on file at the U. S. Soil Conservation Service, Washington, D. C., and the California Institute of Technology, Pasadena, Calif.

Describes experiments performed in a laboratory of the Hydraulic Institute of Padova to test the validity of equations on shearing force developed by DuBoys, Kramer, Schoklitsch, Meyer-Peter, and Conti. Results of experiments confirm the validity of Kramer's formula for shearing force for a given size range and validity of Schoklitsch's formula for different size range of material. Meyer-Peter's expression gave better agreement with the experimental data than Schoklitsch's.

2. Nuove ricerche sulla forza di trascinamento delle correnti liquide (New research on the transporting force of streams). Energia Elettrica, vol. 13, no. 4, Apr. 1936. In Italian. Translation on file at the U. S. Soil Conservation Service, Washington, D. C.

Describes experiments carried out at the Hydraulics Institute of Padova on the critical transporting force of coarse material obtained from the bottom of natural streams. Reviews the formulas and results of studies of previous investigators, including DuBoys, Schaffernak, Kramer, and others. Concludes that various formulas are valid within certain ranges of size materials to which they apply, and that correlation of the critical transporting force cannot be applied to all materials in equal manner. States that Kramer's formula and the author's formula are the best over-all formulas for material of any size.

INDUS RIVER COMMISSION.

1. Indus River Commission records 4, Miscellaneous observations, 30 pp., illus. Karachi, 1907.

Reports results of observations by the Indus River Commission, 1904-05. Includes data on gauge readings at and below Kotri, flood gradients of the Indus, breathings of the Indus at Bukkur and Din Belo, and the depths of scour under caving banks. Reports changes in course of the Indus River above and below Sukkur, and gives the area of bank erosion in this length. The maximum and minimum gaugings at Bukkur and Kotri are given.

2. Indus River Commission records 3, silt observations for the years 1902-1905. 12 pp., illus. Karachi, 1907.
Results of observations on maximum, average, and minimum quantities of sand and sediment per cubic foot of Indus River water at Sukkur and Kotri for the period 1902 to 1905 inclusive.
- INGHAM, W.
1. The Vaal River scheme and barrage. Engineer [London], vol. 134, pp. 576-578, illus., Dec. 1, 1922.
Describes details of construction of the Vaal River Barrage and appurtenant works. Gives data on the silt content of this stream and notes that the barrage structure, consisting of a series of large sluice gates will obviate the danger of the silting up of the reservoir.
- INGLIS, C. C. See also Griffith, W. M., 2; Hawes, C. G., 1; Joglekar, D. V., 6; Anonymous, 127, 129.
1. Some important factors affecting the design and working of Deccan canals. Bombay Engin. Cong., Proc. (1922) vol. 2, pp. 46-74, illus., 1923.
Discusses the effects of the growth of water weeds and of percolation on the design and efficiency of Deccan canals. Considers, among other factors which affect weed growth, the material of bed and silt in suspension and conditions necessary to ensure silty water.
 2. (and Joglekar, D. V.). Note on silt exclusion from canals. II. Bombay Pub. Works Dept., Tech. Paper 46, 45 pp., illus., 1933.
Reports experiments with models with exaggerated scales to check and clarify principles of the open-flow and still-pond methods of excluding heavy bed silt from canals. Description of models, objectives, and results given. Describes experiments on investigations of general principals of scouring and silting, and on the question of still pond versus open flow. Contours of silt deposits in models after certain time intervals are given. Describes experiments with different proportions of silt at various discharges and silt being injected continuously and periodically. Shows effects of opening undersluices to scour out silt from approach channels. Appendices on the design of dynamically similar models in accordance with Lacey's formulas are given. Discusses sizes of various silts used in experiments and the velocities of silt movement.
 3. Notes of May 1931 on silt exclusion from canals, "still pond" versus "open flow." I. Bombay Pub. Works Dept., Tech. Paper 45, 7 pp., illus., 1933.
Describes and compares two methods of excluding heavy silt from off-takes. The open-flow method is the partial opening of few undersluice gates, near the bed at the side of the approach channel farthest from the canal off-take, to draw bed silt away from canal face. The still-pond method is keeping undersluices closed while the canal is flowing; the velocity in approach channel thus being kept low results in deposition of silt in approach channel; when deposit is considerable canal is closed and undersluices opened to scour out silt.
 4. (and Joglekar, D. V.). Factors affecting exclusion of bed silt from canals taking off from alluvial rivers. Bombay Pub. Works Dept., Tech. Paper 52, 31 pp., illus., 1935.
Presents results of experiments to determine factors affecting the movement of bed silt at off-takes from straight alluvial rivers. Considers briefly Lindley's "resultant" theory and Gibb's theory of "silt draw." Experiments are described in which doubling the velocities in a river and canal increased "silt draw" into canal and where the effect of various mechanical improvements at or near off-takes on "silt draw" were determined. Experiments dealing with the movement of rolling bed silt around the nose of a divide wall as well as the exclusion of silt with curved vanes, silt exclusion with and without vanes, scour at nose of dividing wall, and the effect of length of divide wall on silt exclusion are described.
 5. Sinuosity. India Cent. Bd. Irrig. Pub. 11, p. 76, 1936.
A note briefly discussing the factors affecting the sinuosity of rivers.
 6. (and Joglekar, D. V.). Silt control at heads of canals and distributaries. Bombay Pub. Works Dept., Tech. Paper 59, 6 pp., illus., 1938.
Paper describes in detail model studies to determine methods of control of silt entering the Mithrao Canal, India, and conditions causing loss of "command" in Eastern Nara at head of Mithrao Canal (1932). Experiments to restore silt control, restoration of "command," establishment of curvature of flow and conclusions are given.
 7. The use of models for elucidating flow problems based on experience gained in carrying out model experiments at the Hydrodynamic Research Station, Poona. Natl. Inst. Sci. India, Proc., vol. 4, no. 4, pp. 419-439, illus., 1938.
Describes and discusses model studies conducted at the Hydrodynamic Research Station, Poona, for the clarification of flow problems. Includes discussion on regime models in which conditions of flow are maintained constant with complete freedom as regards silting and scouring.
 8. Hydrodynamic research carried out at the Central Irrigation and Hydrodynamic Research Station, Khadakvasla, near Poona, during 1938-39. Sci. and Cult., vol. 6, pp. 430-439, Feb. 1941.
A study made by means of models and in situ of the following problems: (1) Control of silt entering the right bank canals taking off the Sukkur Barrage across the Indus (Sind); (2) training the Sarda River above the barrage at Baubassa; (3) training the Rajuri Nala below an aqueduct in Bombay; (4) the destruction of submersible bridges in the Central Provinces due to turbulent flow.
 9. (and Thomas, A. R., Joglekar, D. V., and staff at Khadakvasla). Accumulation of sand and silt in reservoirs. India Cent. Irrig. and Hydrodynamic Res. Sta., Poona, Res. Pub. 5, pp. 6-7, illus., 1942.
Various graphs and data are shown in regard to sand and silt in reservoirs.
 10. (and Thomas, A. R., Joglekar, D. V., and staff at Khadakvasla). The formation of bed riffles. India Cent. Irrig. and Hydrodynamic Res. Sta., Poona, Res. Pub. 5, pp. 55-56, illus., 1942.
Notes experiments carried out to provide data on bed riffle formation. Some results are given.
 11. (and Thomas, A. R., Joglekar, D. V., and staff at Khadakvasla). Mean diameter of sand silt and sand by sedimentation and sieving compared with that obtained by Puri Siltometer. India Cent. Irrig. and Hydrodynamic Res. Sta., Poona, Res. Pub. 5, p. 7, illus., 1942.
Shows percent of divergence of mean diameter by Puri Siltometer from mean diameter by sieving. Correction factors are given.
 12. (and Thomas, A. R., Joglekar, D. V., and staff at Khadakvasla). Mithrao and Khipro Ex Nara at Makhi (Sind). India Cent. Irrig. and Hydrodynamic Res. Sta., Poona, Res. Pub. 5, pp. 16-18, illus., 1942.
Describes scour experiments with models. The problem and various results of experiments are discussed.
 13. (and Thomas, A. R., Joglekar, D. V., and staff at Khadakvasla). The protection of bridge piers against scour. India Cent. Irrig. and Hydrodynamic Res. Sta., Poona, Res. Pub. 5, pp. 35-39, illus., 1942.
Comments on experiments with a model of Hardinge Bridge pier.
 14. (and Thomas, A. R., Joglekar, D. V., and staff at Khadakvasla). Rate of deposition of sand, as governed by charge and terminal velocity. India Cent. Irrig. and Hydrodynamic Res. Sta., Poona, Res. Pub. 5, pp. 50-52, illus., 1942.
Reviews experiments carried on concerning rate of sand deposition in relation to charge and terminal velocity. Results are given.
 15. (and Thomas, A. R., Joglekar, D. V., and staff at Khadakvasla). Rate of sand attrition in channels. India Cent. Irrig. and Hydrodynamic Res. Sta., Poona, Res. Pub. 5, pp. 41-42, illus., 1942.
An experiment to determine if attrition is the explanation of the progressive reduction of size of bed materials from the hills to the sea.

16. (and Thomas, A. R., Joglekar, D. V., and staff at Khadakvasla). Remodelling Son Anicut. Scour at the noses of divide walls, upstream and downstream of the Anicut and undersluices. India Irrig. and Hydrodynamic Res. Sta., Poona, Res. Pub. 5, pp. 19-21, illus., 1942.

The scour problem is stated and investigations described. Model studies are described. Protective measures are suggested.
17. (and Thomas, A. R., Joglekar, D. V., and staff at Khadakvasla). Scour at nose of outer bank of the new approach channel at Sukkur in prototype and models. India Cent. Irrig. and Hydrodynamic Res. Sta., Poona, Res. Pub. 5, pp. 12-13, illus., 1942.

Describes experiments using prototype and models to determine the relative scour and to link this up with scour around piers. Formulas and methods are given.
18. (and Thomas, A. R., Joglekar, D. V., and staff at Khadakvasla). Scour at spurs in river models. India. Cent. Irrig. and Hydrodynamic Res. Sta., Poona, Res. Pub. 5, pp. 38-41, illus., 1942.

Experiments conducted with models concerning scour. Various results of experiments are given.
19. (and Thomas, A. R., Joglekar, D. V., and staff at Khadakvasla). Scour downstream of Sarda Barrage at Banbassa (U. P.). India Cent. Irrig. and Hydrodynamic Res. Sta., Poona, Res. Pub. 5, pp. 24-25, illus., 1942.

Experiments with models are described. Recommendations to help solve the scour problem are given.
20. (and Thomas, A. R., Joglekar, D. V., and staff at Khadakvasla). Stable sections of small channels in sand of various grades. India Cent. Irrig. and Hydrodynamic Res. Sta., Poona, Res. Pub. 5, pp. 56-58, illus., 1942.

Discusses experiments to obtain relationships between dimensions of small stable channels in various sands, for use in determining suitable scale ratios in river models.
21. (and Thomas, A. R., Joglekar, D. V., and staff at Khadakvasla). Tail channel scouring and regulation. India Cent. Irrig. and Hydrodynamic Res. Sta., Poona, Res. Pub. 5, p. 14, illus., 1942.

Experiment with model studies concerning tail channel scouring and regulation.
22. Hydrodynamic models as an aid to engineering skill. India Cent. Bd. Irrig. Pub. 29, pp. 44-55, illus., 1943.

Describes the models used in a wide range of experiments, and gives the results of the experiments and the limitations of the models. Classifies models into four main types. Formulas included.
23. (and Reid, J. S., Joglekar, D. V., and staff at Khadakvasla). Divergence from regime in stable channels in alluvium. India Cent. Irrig. and Hydrodynamic Res. Sta., Poona, Res. Pub. 6, pp. 2-12, illus., 1944.

Comments on the divergence of opinion and lack of understanding on the "Lacey theory and flow formulas." This paper shows that the main reason for the dimensions of stable channel diverging from those derived from Lacey's regime formulas is his omission of any "sand charge" factor from his formulas. Effects of causes leading to variations in charges in different channels of the same canal system and effects of these variations are explained and it is shown that the main divergences can be eliminated by the use of a formula evolved. Various formulas and data are given.
24. The effect of denudation on river floods. India Cent. Bd. Irrig. Pub. 31, p. 113, 1944.

Flooding of the countryside adjoining alluvial rivers results primarily from the building up of the bed with excess bed material moving down the river. Comments on means to remedy river deterioration and recommends further study.
25. (and Reid, J. S., Joglekar, D. V., and staff at Khadakvasla). The effect of high level pitching laid round bridge piers on the depth of downstream scour. India Cent. Irrig. and Hydrodynamic Res. Sta., Poona, Res. Pub. 6, pp. 31-32, 1944.

Deals with the relation between height of pitching round piers and consequent downstream scour, the model results being linked up with known scour at the Hardinge Bridge. Gives factors causing scour. Use of models is described.
26. (and Reid, J. S., Joglekar, D. V., and staff at Khadakvasla). Effect of method followed in regulating downstream water levels on shape of channels. India Cent. Irrig. and Hydrodynamic Res. Sta., Poona, Res. Pub. 6, pp. 33-34, illus., 1944.

The main object of sand channel experiments has been to obtain dimensions of small stable channels. The result has shown the difficulties of producing natural, stable channels under model conditions. Notes various experiments.
27. (and Reid, J. S., Joglekar, D. V., and staff at Khadakvasla). Effect of residual turbulence on rate of deposition of sand. India Cent. Irrig. and Hydrodynamic Res. Sta., Poona, Res. Pub. 6, p. 33, 1944.

Discusses experiments concerning effect of residual turbulence on rate of sand deposition. Concludes that degree of residual turbulence does not affect, or affects to a small extent, the rate of deposition.
28. (and Reid, J. S., Joglekar, D. V., and staff at Khadakvasla). Final note on new approach channel at Sukkur to control sand entering the right bank canals. India Cent. Irrig. and Hydrodynamic Res. Sta., Poona, Res. Pub. 6, pp. 16-18, illus., 1944.

Describes experiments with river models to control sand entering the Right Bank Canals.
29. (and Reid, J. S., Joglekar, D. V., and staff at Khadakvasla). Hooghly River models. India Cent. Irrig. and Hydrodynamic Res. Sta., Poona, Res. Pub. 6, pp. 23-24, illus., 1944.

Describes experiments with models for controlling sediment and acquiring a knowledge of flow conditions. Purpose of the investigations is to get rid of erosion which has occurred at several points along the foreshore of the Hooghly above Calcutta.
30. (and Reid, J. S., Joglekar, D. V., and staff at Khadakvasla). Mithrao and Khipro Ex. Eastern Nara at Makhli, Sind. India Cent. Irrig. and Hydrodynamic Res. Sta., Poona, Res. Pub. 6, p. 19, illus., 1944.

Discusses use of groynes in controlling sand deposits. Results show the design used was successful.
31. (and Reid, J. S., Joglekar, D. V., and staff at Khadakvasla). Model experiments to verify the efficiency of a proposal made by the station to exclude bed sand from the Sarda Canal by providing a regulator in the short Banbassa spar. India Cent. Irrig. and Hydrodynamic Res. Sta., Poona, Res. Pub. 6, p. 19, illus., 1944.

Describes use of models to verify a proposal to construct a regulator for controlling sediment. Recommends further investigation.
32. (and Reid, J. S., Joglekar, D. V., and staff at Khadakvasla). Remodelling the Son Anicut at Dehri (Bikar)—Control of sand entering channels. India Cent. Irrig. and Hydrodynamic Res. Sta., Poona, Res. Pub. 6, pp. 20-23, illus., 1944.

Comments on experiments involving use of models and dealing mainly with the removal of excess sand from canals. Various designs and data are presented.
33. (and Reid, J. S., Joglekar, D. V., and staff at Khadakvasla). Scour around piers—Influence of upstream bed level and material of bed on maximum scour at pier. India Cent. Irrig. and Hydrodynamic Res. Sta., Poona, Res. Pub. 6, pp. 32-33, illus., 1944.

Explains experiments using various types of sands and different bed levels in regard to scour. Sand graphs are shown. Conclusions are given.
34. The use of attracting spurs for training a river upstream of a masonry work. India Cent. Bd. Irrig. Pub. 31, p. 48-49, 1944; also in Indian Waterways Expt. Sta., Poona, Res. Pub. 7, pp. 46-47, 1945.

Explains "attracting" and "repelling" effects of spurs and the application of "attracting" spurs in training a river upstream of a bridge or barrage.

35. (and Joglekar, D. V., and staff at Khadakvasla). Analysis of Bilot Creek and Paharpur Canal data (Ex. Indus 35 miles downstream of Kalabagh, N. W. F. P.). Indian Waterways Expt. Sta., Poona, Res. Pub. 8, p. 32, illus., 1945.
Discusses an analysis of data from Bilot Creek and Paharpur Canal. Bed sand samples are analyzed and results shown.
36. (and Reid, J. S., Joglekar, D. V., and staff at Khadakvasla). Analysis of catchment characteristics. Indian Waterways Expt. Sta., Poona, Res. Pub. 7, pp. 34-40, illus., 1945.
States the rational formula, usually given for flood discharge from any catchment area. The effect of shape of catchment is discussed in the light of Deccan flood data. The physical meaning of shape factor is discussed. A formula for maximum flood discharge per square mile, and various conclusions are given.
37. (and Joglekar, D. V., and staff at Khadakvasla). Analysis of changes in the course of the River Indus downstream of Kalabagh. Indian Waterways Expt. Sta., Poona, Res. Pub. 8, pp. 8-10, illus., 1945.
Describes effects of changes including effect of constructing the Kalabagh Barrage.
38. (and Joglekar, D. V., and staff at Khadakvasla). Bed ripples and bed waves. Indian Waterways Expt. Sta., Poona, Res. Pub. 8, pp. 53-59, illus., 1945.
Experiments concerning bed ripples and bed waves; a flume being used. Comments on formation of bed ripples and bed waves. A summary and a mechanical analysis diagram of sand from a ripple are included.
39. (and Joglekar, D. V., and staff at Khadakvasla). Cause of accretion of river bed at Sukkur barrage and how to reduce rate of rise. Indian Waterways Expt. Sta., Poona, Res. Pub. 9, pp. 99-104, illus., 1945.
This report notes the cause for accretion at Sukkur Barrage and how it can be reduced. Various data and graphs are given.
40. (and Joglekar, D. V., and staff at Khadakvasla). Deep scour downstream of the North Western Railway bridge over the M. W. canal at Mile 18/13-4, near Ruk, Sind. Experiments carried out to evolve a suitable design of pavement and side expansions to induce accretion. Indian Waterways Expt. Sta., Poona, Res. Pub. 9, pp. 23-25, illus., 1945.
Model experiments were used to evolve a suitable design of pavement and side expansion to induce accretion. Investigation shows that deep scour was due to return flow at the banks leading to the formation of "bellies." Use of juck work (brushwood groynes) is recommended.
41. (and Joglekar, D. V., and staff at Khadakvasla). Denudation, erosion and floods. Indian Waterways Expt. Sta., Poona, Res. Pub. 8, pp. 3-8, illus., 1945.
Discusses three aspects of the problem of denudation of the soil: 1, States the problem of denudation; 2, discusses its relation to India, and 3, gives preventive measures for rising beds and flood damage in India.
42. (and Joglekar, D. V., and staff at Khadakvasla). The design of canals in Sind. Indian Waterways Expt. Sta., Poona, Res. Pub. 8, pp. 21-32, illus., 1945.
Comments on data collected about inundation canals in Sind, and explains wherein inundation canals differ from perennial canals in Sind.
43. (and Joglekar, D. V., and staff at Khadakvasla). Design of lower Sind barrage at Hajipur. Indian Waterways Expt. Sta., Poona, Res. Pub. 9, pp. 55-57, illus., 1945.
Discusses the location of the lower Sind Barrage. Use of a model indicates that one site (Site C) is unfavorable, and another site (Site B) is better because the natural curvature of flow is more favorable for sand exclusion.
44. (and Reid, J. S., Joglekar, D. V., and staff at Khadakvasla). Deterioration of deltaic rivers. Experiments with a model of the Nuna and Pothi Rivers in the Mahanadi Delta (Orissa). Indian Waterways Expt. Sta., Poona, Res. Pub. 7, pp. 7-10, illus., 1945.
Notes experiments with models in connection with deposition of silt and erosion. Conditions of flow are noted.
45. (and Reid, J. S., Joglekar, D. V., and staff at Khadakvasla). Divergence from regime in stable channels in alluvium—analysis of 10 sites on distributaries of the Sarda main canal (U. P.). Indian Waterways Expt. Sta., Poona, Res. Pub. 7, pp. 30-32, illus., 1945.
Various formulas are stated and conclusions in regard to them are put forth.
46. (and Joglekar, D. V., and staff at Khadakvasla). Experiments with a model of the Mahanadi and Katjuri group of rivers near Cuttack, Orissa. Indian Waterways Expt. Sta., Poona, Res. Pub. 8, pp. 37-39, illus., 1945.
The problem, causes, and lines of investigation to solve it are given, including results of a model study.
47. (and Reid, J. S., Joglekar, D. V., and staff at Khadakvasla). Experiments with a model of the Rice Canal in connection with protection of the railway bridge at R. D. 74944. Indian Waterways Expt. Sta., Poona, Res. Pub. 7, pp. 21-24, illus., 1945.
Model experiments to determine method of protecting a railway bridge from scour. Various designs are given.
48. (and Reid, J. S., Joglekar, D. V., and staff at Khadakvasla). Experiments with a 1/600:1/120 model of Indus River upstream of the Bukkur Gore in connection with protection of threatened N. W. Railway embankment. Indian Waterways Expt. Sta., Poona, Res. Pub. 7, pp. 13-14, illus., 1945.
A model study to determine methods of protecting a railway embankment from further erosion.
49. (and Reid, J. S., Joglekar, D. V., and staff at Khadakvasla). Factors affecting meanders of channels. Indian Waterways Expt. Sta., Poona, Res. Pub. 7, pp. 51-55, illus., 1945; also in India Cent. Bd. Irrig., Pub. 31, pp. 45-48, illus., 1944.
Describes experiments to investigate factors governing meander development in channels flowing in incoherent alluvium or the relations connecting meander length and breadth with discharge, sand charge, and slope. Various conclusions are given as to the factors causing the meander belt.
50. (and Joglekar, D. V., and staff at Khadakvasla). Fluctuations of grade of materials exposed on the beds of the eastern Nara and Rothri Canals (Sind). Indian Waterways Expt. Sta., Poona, Res. Pub. 8, p. 35, illus., 1945.
Notes the fluctuations of grade of bed sands from two canals and gives result of this data.
51. (and Joglekar, D. V., and staff at Khadakvasla). Hooghly River model. Indian Waterways Expt. Sta., Poona, Res. Pub. 9, pp. 7-8, illus., 1945.
Describes experiments with the Hooghly River tidal model in an effort to improve flow conditions and reduce scour caused by the River Hooghly.
52. (and Joglekar, D. V., and staff at Khadakvasla). Hooghly River models. Indian Waterways Expt. Sta., Poona, Res. Pub. 8, pp. 35-37, illus., 1945.
The problem is stated. Models constructed to investigate it and experiments with them are described. Various remedies to solve the problem are given.
53. (and Reid, J. S., Joglekar, D. V., and staff at Khadakvasla). Hooghly River tidal models. Indian Waterways Expt. Sta., Poona, Res. Pub. 7, pp. 18-20, illus., 1945.
Conditions studied by models, such as flow conditions, sediment deposition and erosion, are described.
54. (and Joglekar, D. V., and staff at Khadakvasla). Improvement of the Rice Canal due to right bank approach channel at Sukkur. Indian Waterways Expt. Sta., Poona, Res. Pub. 8, pp. 33-35, illus., 1945.
Discusses the result of experiments for the improvement of sand control in the Rice Canal and comments on the effect of the right bank approach canal.
55. (and Joglekar, D. V., and staff at Khadakvasla). Jamshoro Bund on the left bank of the Indus near Hyderabad (Sind). Indian Waterways Expt. Sta., Poona, Res. Pub. 8, pp. 39-40, illus., 1945.
Describes model experiments to prevent scour and gives results.

56. (and Reid, J. S., Joglekar, D. V., and staff at Khadakvasla). Lacey and Kennedy. Indian Waterways Expt. Sta., Poona, Res. Pub. 7, pp. 40-45, illus., 1945.

The report gives the engineer a better idea of the physical significance of the Lacey formulas, and shows how sections and slopes similar to Lacey's can be evolved from V/V_0 and Kutter. Recommends a formula for use in design of channels. Attempts to explain some of the factors affecting shape and indicates Lacey's section and "optimum" ones described in the note have to be modified by channel velocities. Also shows a convenient way of working out the minimum slope required in a lined channel which has to carry silt or sand.
57. (and Joglekar, D. V., and staff at Khadakvasla). Maximum depth of scour at heads of guide banks and groynes, pier noses and downstream of bridges. Indian Waterways Expt. Sta., Poona, Res. Pub. 9, pp. 74-84, illus., 1945.

Describes the occurrence of scour as classified into three groups. Lacey's formula for maximum depths of scour at bends is noted and various conclusions are drawn. The formulas for scour are given. Scour at bridges piers, guide banks groynes, sharp bends, and downstream of bridges is discussed and tabulated.
58. (and Joglekar, D. V., and staff at Khadakvasla). Prevention of further erosion of the left bank of the Rupnarain River above Kolaghat railway bridge of the B. N. Railway. Indian Waterways Expt. Sta., Poona, Res. Pub. 9, pp. 13-20, illus., 1945.

Suggests methods for preventing further erosion by the Rupnarain River upstream from the Bengal-Nagpur Railway Bridge at Kolaghat. The final method, chosen after testing in tidal models, is described.
59. (and Joglekar, D. V., and staff at Khadakvasla). Rate of sand attrition in channels. Indian Waterways Expt. Sta., Poona, Res. Pub. 8, pp. 62-64, illus., 1945.

An experiment to determine how far attrition was the explanation of the progressive reduction of size of bed materials from the hills to the sea, carried out in a circular tank in which water has revolved with a uniform velocity. Gives results.
60. (and Reid, J. S., Joglekar, D. V., and staff at Khadakvasla). Remodeling of Son Anicut at Dehri. Indian Waterways Expt. Sta., Poona, Res. Pub. 7, pp. 14-18, illus., 1945.

Experiments were carried out to determine the best method of preventing coarse sand from entering the canal by improving the design of the Anicut and headworks. Describes model experiments and gives conclusions.
61. (and Joglekar, D. V., and staff at Khadakvasla). Reproduction of curvature in a model. Indian Waterways Expt. Sta., Poona, Res. Pub. 8, pp. 59-62, illus., 1945.

Discusses the effect of centrifugal forces caused by channel flow on a curve and the value of locating a head regulator on the outside of a curve. Derivation of the formula for reproduction of curvature in geometrically-similar and vertically-exaggerated models is given.
62. (and Joglekar, D. V., and staff at Khadakvasla). Sand and silt elutriator—grading sand and silt by washing. Indian Waterways Expt. Sta., Poona, Res. Pub. 8, pp. 64-66, illus., 1945.

Describes use of an open type elutriator to produce materials of known size distribution and containing approximately the correct percentage of suspended load relative to bed load. This is needed to represent the suspended load and bed load in river and canal models. The principle of its working is based on initial turbulence.
63. (and Reid, J. S., Joglekar, D. V., and staff at Khadakvasla). Sand injector. Indian Waterways Expt. Sta., Poona, Res. Pub. 7, p. 56, illus., 1945.

Describes a machine to inject sand in models to reproduce bed load. It has been used satisfactorily to place a uniform charge over the channel width and is especially good for meander work.
64. (and Reid, J. S., Joglekar, D. V., and staff at Khadakvasla). Silt injector. Indian Waterways Expt. Sta., Poona, Res. Pub. 7, p. 56, illus., 1945.

Describes a large-scale "Horlick's mixer" which in conjunction with better grading of silt has led to satisfactory results in model studies.
65. (and Reid, J. S., Joglekar, D. V., and staff at Khadakvasla). Silting of reservoirs with special reference to the Ekruk Tank (Bombay). Indian Waterways Expt. Sta., Poona, Res. Pub. 7, pp. 32-33, illus., 1945.

Describes an investigation concerning the shrinkage of deposited material. Samples of silt deposited on the bed of the Ekruk Tank (Bombay) were analyzed. A brief description of the reservoir is included.
66. (and Joglekar, D. V., and staff at Khadakvasla). Son Anicut at Dehri (Bihar)—Final note on sand excluding heads for the M. E. and M. W. Canals and ejectors for the M. W. Canal. Indian Waterways Expt. Sta., Poona, Res. Pub. 9, pp. 58-59, illus., 1945.

Shows sand excluder designs for canals at Dehri-on-Son and discusses the problem.
67. (and Joglekar, D. V., and staff at Khadakvasla). Son Anicut at Dehri (Bihar)—Sand excluding heads for the M. E. and M. W. Canals and ejector for the M. W. Canal. Indian Waterways Expt. Sta., Poona, Res. Pub. 8, pp. 40-44, illus., 1945.

Reviews experiments for sand exclusion by using models and states various conclusions.
68. (and Joglekar, D. V., and staff at Khadakvasla). Son at Dehri Bihar—Protective measures below the new undersluices. Indian Waterways Expt. Sta., Poona, Res. Pub. 9, pp. 20-23, illus., 1945.

Describes the use of models to evolve the best design for preventing scour below new undersluices.
69. (and Joglekar, D. V., and staff at Khadakvasla). Summary of technical enquiry into the causes of breaches in River Bunds in Sind and steps required to minimize the danger of a recurrence. Indian Waterways Expt. Sta., Poona, Res. Pub. 8, pp. 10-21, illus., 1945.

Describes area inundated during floods of 1942, and deals historically with the steps taken by the Government since 1861. An analysis is made of all available data regarding rate of rise of flood levels in the past and probable rate of rise hereafter as affected by various changes. The danger which lies ahead in upper Sind is summarized and recommendations are made to minimize the risk of future breaches.
70. (and Reid, J. S., Joglekar, D. V., and staff at Khadakvasla). Training the Malaprabha River—Experiments to compare relative merits of various attentive measures for relieving heavy scour at the Highway Bridge abutment. Indian Waterways Expt. Sta., Poona, Res. Pub. 7, pp. 10-13, illus., 1945.

Report deals with experiments to determine measures to relieve scour at a railway bridge abutment. Conclusions are stated.
71. (and Joglekar, D. V., and staff at Khadakvasla). Transportation of pebbles in flumes. Indian Waterways Expt. Sta., Poona, Res. Pub. 8, pp. 47-52, illus., 1945.

Discusses experiments to determine the slope required in a pebble-bed flume to carry various charges and grades of material with various discharges. Also describes flumes, material used, procedures, and results, and cites various formulas.
72. (and Reid, J. S., Joglekar, D. V., and staff at Khadakvasla). The use of attracting spurs for training a river upstream of a masonry work. Indian Waterways Expt. Sta., Poona, Res. Pub. 7, pp. 46-47, 1945.

Explains the "attracting" and "repelling" effects of spurs. Considers the application of the principle of "attracting" spurs to training a river upstream of a bridge or a barrage.

INGLIS, W. A.

1. The Bidyadhari and the Salt Lakes. Indian Engin., vol. 54, pp. 248-250, Nov. 1, 1913.

Deals with the determination of capacity changes in the River Bidyadhari and the Salt Lakes tidal spill basins. Causes and conditions of silting in the lakes and stream channel are included.

1. Sorting of sediments in the light of fluid mechanics. *Jour. Sedimentary Petrology*, vol. 19, no. 2, pp. 51-70, illus., Aug. 1949.

A report which shows that a physical relationship exists between skewness, median diameters, and sorting of sediments. Notes that an investigation of principles of fluid mechanics involved in sediment transportation and deposition shows three primary controlling factors which are threshold velocity, settling velocity, and degree of bottom roughness. Points out that the relationship of sorting and skewness to the median diameter of a sediment may present a clue as to the processes under which the sediment was transported and deposited.

INTERDEPARTMENTAL COMMITTEE. See U. S. Interdepartmental Committee.

INTERNATIONAL BOUNDARY COMMISSION, UNITED STATES AND MEXICO.

1. Defensive works on the Rio Grande at Brownsville, Texas, and Matamoros, Tamaulipas. In *Internatl. Boundary Commn., U. S. and Mex. Proc...* Equitable distribution of the waters of the Rio Grande, vol. 1, pp. 27-34, illus., Washington, 1903.

Deals with bank protection works and proposed jetty alteration on the Rio Grande between Brownsville and Fort Brown, Tex., and Matamoros, Tamaulipas. A joint report of the engineers, W. W. Follett and E. Corella, is included.

2. Flow of the Rio Grande and tributary contributions. *Internatl. Boundary Commn. U. S. and Mexico*, Water Bul. 1, 38 pp., illus., 1931.

Presents results of stream flow and dissolved- and suspended-load determinations of Rio Grande water, including data on gravimetric percentages of dried silt in the Rio Grande at Boquillas (1928-31), Roma (1924-26, 1929-31), Fort Quitman and El Paso (1923-25), Upper Presidio Station (1924-26), Lower Presidio Station (1924-31), and Laredo (1924-31) Tex., and at Matamoros, Tamaulipas (1924-26); and data on tons of suspended silt in the Rio Grande at Roma, Tex. (1929-31).

3. Flow of the Rio Grande and tributary contributions. *Internatl. Boundary Commn. U. S. and Mexico*, Water Bul. 2, 54 pp., illus., 1932.

Presents results of stream flow and dissolved- and suspended-load determinations of waters of the Rio Grande. Summaries of suspended silt in the Rio Grande at San Marcial (1926-32), at El Paso (1924-32), at Fort Quitman (1928-32), and at Roma (1932) are given.

4. Flow of the Rio Grande and tributary contributions. *Internatl. Boundary Commn. U. S. and Mexico*, Water Bul. 3, 64 pp., illus., 1933.

Presents results of stream flow and dissolved- and suspended-load determinations of Rio Grande water for 1933. Data are given on gravimetric percentages of dry silt and tons of suspended silt in the Rio Grande at San Marcial, N. Mex. and at Roma, Tex.

5. Flow of the Rio Grande and tributary contributions. *Internatl. Boundary Commn. U. S. and Mexico*, Water Bul. 4, 70 pp., illus., 1934.

Presents results of stream flow and dissolved- and suspended load determinations of the Rio Grande for 1934. Data on silt in the Rio Grande at San Marcial, Eagle Pass, and Roma; in the Rio Alamo at Mier; and in the Rio San Juan at Santa Rosalia are given.

6. Flow of the Rio Grande and tributary contributions. *Internatl. Boundary Commn. U. S. and Mexico*, Water Bul. 5, 101 pp., illus., 1935.

Presents results of stream flow and dissolved- and suspended-load determinations of Rio Grande water (1935). Data are given on suspended silt in the Rio Grande at San Marcial, Eagle Pass, and Roma; in the Rio Alamo at Mier; and in the Rio San Juan at Santa Rosalia.

7. Flow of the Rio Grande and tributary contributions. *Internatl. Boundary Commn. U. S. and Mexico*, Water Bul. 6, 103 pp., illus., 1936.

Presents data on stream flow, dissolved- and suspended-load determinations for the Rio Grande and its tributaries (1936). Gives data

on suspended silt in the Rio Grande at San Marcial, Eagle Pass, and Roma; in the Rio Alamo at Mier; and in the Rio San Juan at Santa Rosalia. Comparative annual Rio Grande silt burdens for 1926-36 are given.

8. Flow of the Rio Grande and tributary contributions. *Internatl. Boundary Commn. U. S. and Mexico*, Water Bul. 7, 75 pp., illus., 1937.

Presents data on stream flow of the Rio Grande and its tributaries and dissolved- and suspended-load determinations for 1937. Includes data on rate of silting and average density of silt in the Elephant Butte Reservoir. A graph is given showing the relationship between rate of flow of water and suspended silt at the Roma gauging station (1929-37) and relationship between rate of flow of suspended silt at Roma Eagle Pass.

9. Flow of the Rio Grande and tributary contributions. *Internatl. Boundary Commn. U. S. and Mexico*, Water Bul. 8, 80 pp., illus., 1938.

Presents results of stream flow and dissolved- and suspended-load determinations of the Rio Grande and its tributaries for 1938. A table showing acre-feet of suspended silt passing San Marcial in the Rio Grande (1925-38) is given. Data are given on suspended silt in the Rio Grande at Eagle Pass and Roma, in Rio Alamo at Mier, and in the Rio San Juan at Santa Rosalia (1938). Includes data on chemical analyses of water samples.

10. Flow of the Rio Grande and tributary contributions. *Internatl. Boundary Commn. U. S. and Mexico*, Water Bul. 9, 100 pp., illus., 1939.

Presents results of stream flow and dissolved- and suspended-load observations on the Rio Grande and its tributaries for 1939. Data are given on gravimetric percentages of dried silt in the Rio Grande and tributaries, and suspended silt passing San Marcial, N. Mex. and Eagle Pass and Roma, Tex.; in the Rio Alamo at Mier, Tamaulipas; and in the Rio San Juan at Santa Rosalia, Tamaulipas. Results of chemical analyses of water samples from the Rio Grande and its tributaries at various stations are given.

11. Flow of the Rio Grande and tributary contributions. *Internatl. Boundary Commn. U. S. and Mexico*, Water Bul. 10, 111 pp., illus., 1940.

Presents results of stream flow and dissolved- and suspended-load observations on the Rio Grande and its tributaries for 1940. Data are given on gravimetric percentages of dried silt in the Rio Grande and its tributaries, and suspended silt passing San Marcial, N. Mex., and Eagle Pass and Roma, Tex.; in the Rio Alamo at Mier, Tamaulipas; and in the Rio San Juan at Santa Rosalia, Tamaulipas. Results of chemical analyses of water samples from the Rio Grande and its tributaries at various stations are given.

12. Flow of the Rio Grande and tributary contributions. *Internatl. Boundary Commn. U. S. and Mexico*, Water Bul. 11, 84 pp., illus., 1941.

Presents the results of stream flow and dissolved- and suspended-load observations on the Rio Grande and its tributaries for 1941. Contains data on gravimetric percentages of dried silt in the Rio Grande and its tributaries; and suspended silt passing San Marcial, N. Mex., Eagle Pass and Roma, Tex., and the Rio Alamo and Rio San Juan stations. Results of chemical analyses of water samples from the Rio Grande and its tributaries at various station are given.

13. Flow of the Rio Grande and tributary contributions. *Internatl. Boundary Commn. U. S. and Mexico*, Water Bul. 12, 100 pp., illus., 1942.

Presents results of stream flow and dissolved- and suspended-load observations on the Rio Grande and its tributaries for 1942. Contains data on gravimetric percentages of dried silt in the Rio Grande and its tributaries, and suspended silt passing San Marcial, N. Mex., Eagle Pass and Roma, Tex., and the Rio Alamo and Rio San Juan stations. Results of chemical analyses of water samples from the Rio Grande and its tributaries at various stations are given.

INTERNATIONAL BOUNDARY COMMISSION. -
Continued

14. Flow of the Rio Grande and tributary contributions. Internatl. Boundary Commn. U. S. and Mexico, Water Bul. 13, 97 pp., illus., 1943.
Presents results of stream flow and dissolved- and suspended-load observations on the Rio Grande and its tributaries for 1943. Gives data on gravimetric percentages of dried silt in the Rio Grande and its tributaries, and suspended silt passing Buenos Aires station, San Marcial, N. Mex., Eagle Pass and Roma, Tex., and the Rio Alamo and Retamal Canal stations. Results of chemical analyses of water samples from the Rio Grande and its tributaries at various stations are given.

15. Flow of the Rio Grande and tributary contributions. Internatl. Boundary Commn. U. S. and Mexico, Water Bul. 14, 108 pp., illus., 1944.
Presents results of stream flow and dissolved- and suspended-load observations on the Rio Grande and its tributaries for 1944. Gives data on gravimetric percentages of dried silt in the Rio Grande and its tributaries, and suspended silt passing the San Marcial, Langtry, Eagle Pass, Roma, and Buenos Aires stations; and at the Pecos River station near Comstock and the Retamal Canal station. Results of chemical analyses of water samples from the Rio Grande and its tributaries at various stations are given.

INTERNATIONAL BOUNDARY AND WATER COMMISSION, UNITED STATES AND MEXICO.

1. Flow of the Rio Grande and tributary contributions. Internatl. Boundary and Water Commn. U. S. and Mexico, Water Bul. 15, 96 pp., illus., 1945.
Presents results of stream flow and dissolved- and suspended-load observations on the Rio Grande and its tributaries for 1945. Gives data on gravimetric percentages of dried silt in the Rio Grande and its tributaries, and suspended silt for the Rio Grande at San Marcial, Rio Conchos at Cuchillo Parado, Chihuahua; Rio Grande at Langtry, Pecos River, Eagle Pass, Rio Alamo, Roma, and Retamal Canal stations. Results of chemical analyses of water samples from the Rio Grande and its tributaries at various stations are given.
2. Flow of the Rio Grande and tributary contributions. Internatl. Boundary and Water Commn. U. S. and Mexico, Water Bul. 16, 88 pp., illus., 1946.
Presents results of stream flow and dissolved- and suspended-load observations on the Rio Grande and its tributaries for 1946. Gives data on gravimetric percentages of dried silt in the Rio Grande and its tributaries, and on suspended silt at the following stations: Rio Grande at San Marcial; Rio Conchos at Cuchillo Parado, Chihuahua; Rio Grande at Langtry; Pecos River station; Eagle Pass, Rio Alamo station; Roma; Retamal Canal; and Las Palmas station. Results of chemical analyses of water samples from the Rio Grande and its tributaries at various stations are given.
3. Flow of the Rio Grande and tributary contributions. Internatl. Boundary and Water Commn. U. S. and Mexico, Water Bul. 17, 91 pp., 1947.
Presents results of stream flow and dissolved- and suspended-load observations on the Rio Grande and its tributaries for 1947. Gives data on gravimetric percentages of dried silt in the Rio Grande and its tributaries, and suspended silt at the following stations: Rio Grande at El Paso; Rio Conchos at Cuchillo Parado, Chihuahua; Rio Grande at Langtry; Pecos River; Rio Grande at Eagle Pass; Rio Alamo, Rio Grande at Roma; Retamal Canal; and Rio Grande at Las Palmas. Results of chemical analyses of water samples from the Rio Grande and its tributaries at various stations are included.

INTERSTATE COMMISSION ON THE POTOMAC RIVER BASIN.

1. A report on the conditions existing in the Potomac River Basin. 61 pp., illus. Washington, 1945.
Considers such subjects concerning the Potomac River as forest areas, wildlife, water power, water supply, pollution, flood protection, erosion, silt, and mosquito control. Comments on the silt problem of the Potomac River

Basin and notes that the U. S. Corps of Engineers reports an average of 196,000 cu. yd. of silt is deposited in the tidewater navigation channels of the Potomac in the Washington area and that the flood of 1936 deposited 367,000 cu. yd.

IONIDES, M. G. See also Anonymous, 150.

1. Scour in river beds. Engineer [London], vol. 160, no. 4154, pp. 196-197, illus., Aug. 23, 1935; [abstract], Civ. Engin., vol. 5, no. 12, p. 12, Dec. 1935.

Describes quantitative methods for the examination of conditions of scour in river beds and states that the tendency of many rivers to change beds irrespective of artificial control measures is a most important and variable factor in the development of anti-scouring devices.

2. The regime of the River Euphrates and Tigris. 278 pp., illus. London, E. & F. N. Spon, Ltd., 1937.

General hydraulic survey of the basins of the Euphrates and Tigris Rivers with particular reference to their lower reaches. Contains information for use by irrigation engineers. One chapter on river-bed instability and silt describes silt content of both rivers, and gives tables and curves showing relationship of silt to water discharge.

IOWA INSTITUTE OF HYDRAULIC RESEARCH. See U. S. Interdepartmental Committee.

IOWA STATE PLANNING BOARD. WATER RESOURCES COMMITTEE.

1. A report on water use and conservation in Des Moines, Skunk, and South Eastern Iowa River basins in Iowa. 120 pp., illus. Iowa City, 1936. (Water use and conserv. in Iowa, vol. 2).
Deals with existing conditions of and proposed improvements to water use developments and conservation practices in river basins in southeastern Iowa. Notes conditions of stream pollution due to soil erosion, silt load of Des Moines River, silting in natural lakes and means of silt removal, and bank erosion.

IRELAND, H. ANDREW.

1. "Lyell" gully, a record of a century of erosion. Jour. Geol., vol. 47, no. 1, pp. 47-63, Jan./Feb. 1939.

A documented historical review of over 110 yr. of erosion as shown by the study of Lyell Gully near Milledgeville, Ga. Sir Charles Lyell first studied the gully in 1846 and because of his description it is possible to reconstruct the conditions of 1846 and interpret the changes since that date.

IRVINE, E. S. J.

1. Tests at the Bonnet Carré spillway. Military Engin., vol. 21, no. 120, pp. 487-491, illus., Nov./Dec. 1929.

Technical article on the history, geography, design and model testing of Bonnet Carré spillway from Bonnet Carré Point to Lake Pontchartrain. Tests using a one-sixth scale model indicate that silting will take place in the floodway at a velocity of 2 ft. per sec. and below. This is not serious because the spillway will only be used occasionally since the Mississippi River banks at this point are higher than the surrounding country by almost 14 ft.

2. Control of floods in the alluvial valley of the lower Mississippi River—the Bonnet Carré spillway hydraulics, etc. 71st. Cong., 3d sess., H. Doc. 798, vol. 1, pp. 201-238, illus., 1931.

Presents results of field and laboratory investigations relative to the design of the proposed Bonnet Carré spillway. Notes the estimated rate of silting in the floodway itself and in the upper end of Lake Pontchartrain. Gives data, ascertained from flume studies, relative to the most desirable method of operating the spillway to reduce silting to a minimum.

IRVINE, THOMAS D. See Harris, R. J., 1.

IRWIN, G. M.

1. Watershed protection and control. Amer. Water Works Assoc. Jour., vol. 28, no. 8, pp. 1075-1089, Aug. 1936.

Deals with the protection and control of watersheds. Discusses sanitary regulations governing watersheds citing the Province of British

Columbia Health Act. Comments on a paper (Hoyt, W. G., 1) on forests and stream flow and outlines results of investigations by U. S. Forest Service in Wagonwheel Gap, Colo. (1910-26) and by U. S. Geological Survey (begun in 1916) in Fish Creek area, Calif. Discusses hydrology of the areas and conditions of denudation by fire; also erosion in the Wagonwheel Gap and Fish Creek areas. Notes damages caused by silt deposits that occurred in the first year after denudation by fire in the southern California area. Includes discussions of papers by Hoyt and Troxell, Bates, Stevens, Blaney, Mead, and Cecil.

IRWIN, WILLIAM HENRY.

1. Methods of precipitating colloidal soil particles from impounded waters of central Oklahoma. Okla. Agr. Col. Bul., vol. 42, no. 11, 16 pp., illus., Apr. 1945.

Presents observations in turbidities due to colloidal soil particles in some impounded waters of Oklahoma. Points out that the removal of submerged aquatic plants is followed by increased turbidity, and that materials which release positive ions cause the precipitation of soil particles. Discusses and speculates on problems concerning the precipitation of colloidal soil particles from waters. Impoundments were clear when large areas of their basin have good growths of submerged higher aquatic life, when organic matter is carried in them from watersheds, and commercial fertilizer or organic matter has been added to the water recently.

ISLUR, R. G.

1. Relation between the values of rugosity coefficients of Kutter, Manning, Lacey and Barnes [abstract]. India Cent. Bd. Irrig. Pub. 29, p. 100, 1943.
Relations of rugosity coefficients of Kutter, Manning, Lacey, and Barnes are worked out mathematically with reference to R.
2. Silting of reservoirs in the Bombay Deccan. India Cent. Bd. Irrig. Pub. 29, pp. 141-142, 1943.
Discusses observations made to determine the amount of silt deposited in the reservoir annually, the weighted mean diameter of silt particles suspended in the flood waters passing over the waste weir, and an analysis of a profile of deposited silt in the basins of tanks and lakes. Results are stated.
3. Stable channels in alluvium [abstract]. India Cent. Bd. Irrig. Pub. 29, p. 82, 1943.
Discusses hydraulic characteristics of canals in Bombay Deccan which are compared with the designed sections and with Lacey's formulas. Some disagreement is shown.

IVES, ROLAND L.

1. Desert floods in the Sonoyta Valley. Amer. Jour. Sci., (ser. 5) vol. 32, no. 191, pp. 349-360, illus., Nov. 1936.
Describes floods in the Sonoyta Valley near Sonoyta, District of Altar, Sonora, Mexico; climate, inhabitants, plant cover, and precipitation and runoff. Depicts the primary flood of the Sonoyta River during the 1931 season, the conditions of erosion and the deposition of sediment in the valley and town areas, the rate of sediment precipitation in sample of river water, and the microscopic examination of sediment particles. Discusses the stream and playa floods of 1933, the secondary floods of 1931 and 1933, and other important factors. Shows the relation between the type of precipitation, its location and the type of flood produced.

JACKSON, CLARENCE E.

1. (and Saeger, C. M., Jr.). Use of the pipette method in the fineness test of molding sand. U. S. Natl. Bur. Standards, Jour. Res., vol. 14, no. 1, pp. 59-65, Jan. 1935.
Outlines details of the development and use of the pipette method in the fineness test of molding sands. Gives the method of computation. Suggests a rapid method suitable for foundry control work and routine testing.

JACKSON, M. L.

1. (and others). Weathering sequence of clay-size minerals in soils and sediments. Jour. Phys. and Colloid Chem., vol. 52, no. 7, pp. 1237-1260, illus., Oct. 1948.

S. A. Tyler, A. L. Willis, G. A. Bourbeau, and R. P. Pennington, joint authors.
Traces the weathering sequence or stability series of the finer minerals in soils and sediments. Interprets the order of succession of minerals in the sequence using as a basis various concepts of crystal chemistry.

JACKSON, T. H.

1. Flood control on alluvial rivers. I. Engin. News-Rec., vol. 106, no. 2, pp. 58-63, illus., Jan. 8, 1931.
Deals with the factors to be considered in preparing a flood plan and plans for flood control on alluvial rivers. Includes brief description of the characteristics of alluvial rivers.
2. Flood control on alluvial rivers. III. Engin. News-Rec., vol. 106, no. 4, pp. 144-148, illus., Jan. 22, 1931.
Describes the flood-control works employed on the Mississippi River and gives descriptions of the various types of bank revetment works.

JACOBS, JOSEPH.

1. Retrogression of river beds [letter to editor]. Engin. News-Rec., vol. 113, no. 24, p. 768, Dec. 13, 1934.
Retrogression of levels in river beds below dams, (Lane, E. W., 3) with particular reference to Colorado River conditions prior to 1917. Gage readings at Yuma, Ariz. from 1878 to 1917 are cited and analyzed. The rate of growth of the Delta into the Gulf of California confirms gage readings which indicate that the average annual aggradation at Yuma over that period was 0.155 ft. Note is made of the break of the river into the Salton Sea, of the diversion of the Bee River Channel into Volcano Lake, and the construction of Laguna Dam, all contributing to grade recession. The writer concludes that the influences causing excessive aggradation are moderating and results of aggradation are not a serious problem at present.

JACOBSEN, A. E.

1. (and Sullivan, W. F.). Method of particle size distribution for the entire subsieve range. Analyt. Chem., vol. 19, no. 11, pp. 855-860, illus., Nov. 1947.
Discusses the theory underlying the use of a sedimentation pan, cylindrical cup, and specific gravity cylinder. Shows the mathematical equivalence of the sedimentation and specific methods. Employs a modified sedimentation balance which uses a tall cylindrical cup for the determination of distribution of particle size for the subsieve range of size down to 1.0 micron. Obtains composite particle-size distribution curves for the complete subsieve range by the use of cylindrical cup and centrifugal sedimentation methods.

JAEGER, C.

1. Transport of rolled solid materials. Paris Acad. des Sci. Compt. Rend., vol. 210, no. 6, pp. 208-210, Feb. 5, 1940; [abstract], Sci. Abs., vol. 43 A, p. 278, Apr. 1940.
Examines critically various empirical formulae for limiting discharge, entraining force and velocity in the transport of rolled materials over a mobile bed. States that Froude's generalized law of similitude holds in the transport of matter which is not too fine and is rolled along in turbulent motion.
2. Equations of flow of water over a mobile bed. Paris Acad. des Sci. Compt. Rend., vol. 210, no. 13, pp. 472-474, Mar. 27, 1940; [abstract], Sci. Abs., vol. 43 A, pp. 378-379, May 1940.
Shows that contrary to the conclusion of Veronese, the empirical formula for the erosion of a bed by water does not conform with Froude's law of similitude. Suggests that the law proposed by Meyer-Peter, Foure, and Einstein regarding the transport of solids possesses the character of a physical law.

JAGGAR, T. A., JR.

1. Experiments illustrating erosion and sedimentation. Harvard Univ. Mus. Compar. Zool. Bul., vol. 49, pp. 285-305, illus., Mar. 1908.
Describes experiments conducted in the Laboratory of Experimental Geology, Harvard University, designed to perfect apparatus for

reproducing rill patterns in the laboratory. Explains the devices used to produce seepage rills through a sand bank. Discusses conditions of underground drainage areas and "stream shadow" tributary development, and production in model of arborescent rills by flooding. Describes "Grand Canyon" model showing the relative power of erosion due to water volume and slope; delta bed formation; model experiments showing trickle pattern on clay, slime sprayed with atomizers to form patterns, and stream robbery; the reproduction in miniature, of the conditions of stream meanders, piracy, digitation, corrosion, aggradation, and delta building. Principles involved in the reproduction of rill patterns are noted.

JAGODIN, N. N.

1. Study of silting at Zemo-Avchal Hydroelectric Plant. Sci. Res. Inst. Hydrotechnics, Trans., vol. 6, pp. 192-225, illus., 1932. In Russian. Translation on file at the U. S. Soil Conservation Service, Washington, D. C.
Report on an investigation by the Scientific Research Institute of Hydrotechnics (1930) on silting conditions at the Zemo-Avchal Hydroelectric Plant, U. S. S. R. Discusses the extent of silting, effect of future deposits at head-works, and the ineffectiveness of desilting agents.
2. Investigation of silt movement at the Kadyria Hydroelectric Plant. Sci. Res. Inst. Hydrotechnics, Trans., vol. 16, pp. 160-197, 1935. In Russian with an abstract in English. Translation on file at the U. S. Soil Conservation Service, Washington, D. C., and the University of California, Berkeley, Calif.

Describes an investigation of the motion and deposition of silt at the Kadyria Hydroelectric Plant on the Boz-su irrigation canal near Tashkent, Central Asia, by the Research Institute of Hydrotechnics in the summer and fall of 1932. The bulk of the silt originates in the Chirchik River. The effect of flushing the canal by bottom sluices is compared with results of laboratory experiments by Schoklitsch and by the Research Institute of Hydrotechnics. The erosive effect of silt particles on turbine parts is discussed.

JAHNS, RICHARD H.

1. Geologic features of the Connecticut Valley, Massachusetts as related to recent floods. U. S. Geol. Survey, Water-Supply Paper 996, 158 pp., illus., tables, 1947.
Gives the results of a geologic study of certain features that bear upon the recent flood behavior of rivers flowing in the Massachusetts part of the Connecticut Valley. Outlines the physiographic history of the Connecticut River from the mesozoic time to the present. Discusses erosional and depositional processes associated with the extraordinary floods of March 1936 and September 1938. Mechanical analyses of suspended-load deposits and sieve analyses of bed-load samples were made. Microscopic examinations for mineral and rock constituents are included. Gives recommendations for protection against future floods.

JAKUSCHOFF, PAUL.

1. Die Schwebestoffbewegung in Flüssen in Theorie und Praxis (Movement of suspended matter in rivers in theory and practice). Wasserwirtschaft, vol. 25, no. 5, 6, 7, 8, 11, 1932; also in Berlin, Technische Hochschule, Institut für Wasserbau, Mitt. no. 10, 24 pp., 1932. In German. Translation on file at the U. S. Soil Conservation Service, Washington, D. C., and the California Institute of Technology, Pasadena, Calif.
Attempts to indicate the correct methods to be employed, in accordance with present concepts, in the clarification of the problems involved in the mathematical analysis of the movement of suspended materials in rivers. Discusses the significance and the procedure in the determination of the mechanical composition of suspended matter; the character of turbulent flow; methods for computing the movement of suspended matter based on knowledge

of the cross-velocity flow pattern; the magnitude and distribution of the cross components of the flow velocity based on the composition of the suspended matter; the effect of specific load capacity for solid material upon the magnitude of suspended matter of given concentration and composition which can be carried in flowing water; the distribution of critical grain sizes of suspended matter over a cross section and over the length of a river; conditions of suspended-load transportation; calculation of total suspended load; the effect of suspended material upon a stream; instruments for the determination of suspended-matter movement; the photo-electric method of examining the transportation of suspended matter; and the comparison of suspended matter movement in water and in air.

2. Zur Frage der vereinfachten Schwebestoffuntersuchung nach Gehalt und Zusammensetzung (Regarding the question of suspended sediment investigation according to the content and composition). Kulturtechniker, vol. 36, no. 4, pp. 424-437, Oct./Dec. 1933; also in Berlin, Technische Hochschule, Institut für Wasserbau, Mitt. no. 17. In German. Translation on file at the U. S. Soil Conservation Service, Washington, D. C.
Discusses the idea of simplified investigations of suspended sediment according to content and composition. Various formulas pertaining to suspended sediment are given. Comments in determination of the mean terminal velocity of a suspended sediment sample, determination of the content and composition of a suspended sediment sample, and characteristics of the suspended sediment.

JAMES, M. C.

1. Propagation of pondfishes. U. S. Bur. Fisheries, Ann. Rpt. 1929, pp. 19-50, illus., 1930.
Discusses the various factors to be considered in the propagation of fish in natural and artificial ponds. Describes briefly the means of constructing ponds off streams which transport mud and debris. Notes the effect of sediment deposition on fish life.

JAMESON, CHARLES DAVIS.

1. River, lake, and land conservancy in portions of the Provinces of Anhui and Kiangsu, North of Yangtze River [abstract]. Engin. News, vol. 70, no. 13, pp. 588-593, illus., Sept. 25, 1913.
Describes Chinese famine and relief work in portions of Anhui and Kiangsu Provinces due to floods. Notes principal causes of floods are silting of lower reaches of rivers and the silting of Hungtze Lake which receives discharge of entire Huai catchment area, and which has no adequate outlet. Silt carried in suspension by flood waters of Huai are small in comparison to that of the Haiho, Tientsin, Yellow, and Yangtze Rivers.

JAMESON, JOHN A., JR. See Vogel, H. D., 9.

JARRAD, FREDERICK W.

1. River erosion—the Hooghly. I [letter to editor]. Indian Engin., vol. 40, p. 14, July 7, 1906.
Describes conditions of stream bank erosion on the River Hooghly and criticizes the view of the Port Commissioners of Calcutta who state that to arrest bank erosion on the stream is both dangerous and futile.
2. River erosion—the Hooghly. II [letter to editor]. Indian Engin., vol. 40, p. 31, July 14, 1906.
Discusses the various causes of bank erosion in the tidal portions of the River Hooghly.

JARVIS, CLARENCE S. See also Grover, N. C., 12; Kelly, W., 1; LaRue, E. C., 2; Robinson, H. F., 1; Sonderegger, A. L., 2; Stevens, J. C., 6; Todd, O. J., 10; Vanoni, V. A., 1; Witzig, B. J., 1; Woodward, S. M., 1.

1. Early contributions to Mississippi hydrology. Amer. Soc. Civ. Engin., Proc., vol. 68, no. 3, pp. 421-444, Mar. 1942.
Assembles fragmentary hydrologic data from earliest possible records and integrates them into a continuous record covering 122 yr. up to 1938. Treats trends of precipitation and resulting runoff depths. Includes a table giving data on suspended sediment observations for various stations in the Mississippi River.

JEFFERSON, M. S.

1. Limiting width of meander belts. *Natl. Geog. Mag.*, vol. 13, no. 10, pp. 373-384, illus., Oct. 1902.

An article which attempts to establish a limit for the width of the belt of meanders of any given stream. Notes that the limit is eighteen times the mean width of the stream, the depth of water and volume of discharge being negligible.

JEFFERY, G. B.

1. The motion of ellipsoidal particles immersed in a viscous fluid. *Roy. Soc. London, Proc.*, ser. A vol. 102, no. A715, pp. 161-179, Nov. 1, 1922.
Gives a mathematical treatment of the motion of ellipsoidal particles in a viscous fluid. Treats the requisite solution of equations of motion of the fluid. Considers the forces acting upon the particle as a whole, the motion of a particle which is subject to no forces except those arising from the pressure of fluid on its surface, dissipation of energy, and viscosity of suspensions. Solves the problem in the case of spheroidal particles immersed in a very viscous fluid, which moves parallel to a plane with a uniform shearing motion; solution showing that the motion depends on initial conditions of release of the particle. Introduces the hypothesis that ellipsoidal particles immersed in a moving viscous fluid will assume certain definite orientations in relation to the motion of the fluid.

JEFFREY, J. P.

1. Report on the deposit and scour of silt in the Main Line, Sirhind Canal, and on the silt experiments, 1893 to 1898. *Punjab Pub. Works Dept., Irrig. Branch Papers* 9, 82 pp., illus., June 1, 1898.
Deals with the working of the Sirhind Canal since the completion of improvement as recommended in the reports of 1893 and silt deposition in the Main Line, Sirhind Canal. Gives the results of silt experiments, including such items as analysis of silt, classification of sand, residual deposit in canal, quantities of silt carried at different depths, silt movers, and sand separators.

JEFFREYS, HAROLD.

1. On the transport of sediments by streams. *Cambridge Phil. Soc., Proc.*, vol. 25, pt. 3, pp. 272-276, July 1929.
Gives the classical hydrodynamic explanation for the ability of moving water to lift and carry sediments in suspension or to move sediments along the bottom of a stream.
2. On fluid motions produced by differences of temperature and humidity. *Roy. Met. Soc. Quart. Jour.*, vol. 51, no. 216, pp. 347-356, Oct. 1935.
Shows that the maintenance of a difference of temperature between parts of the same level surface in a fluid will necessarily maintain a permanent motion of the fluid, and notes that heating or cooling a fluid at an internal boundary will maintain permanent movement. Notes that a corresponding theorem is true for the supply of new constituents instead of heat.

JENKINS, DAVID S.

1. Silt samples compared in special tests. *Civ. Engin.*, vol. 11, no. 1, pp. 3-6, illus., Jan. 1941.
Presents results of tests with silt sampling instruments to evaluate their relative suitability under practical operating conditions. Tests were conducted on the Brazos River near Waco, Tex. with TVA, Taint-Binckley, Eakin, U. S. Geological Survey, and Paris silt samplers to determine accuracy, speed and ease of operation, and influence of the submersion period.

JENNINGS, D. S.

1. (and Thomas, M. D., and Gardner, Willard). A new method of mechanical analysis of soils. *Soil Sci.*, vol. 14, no. 6, pp. 485-499, illus., Dec. 1922.
Describes a new method for the mechanical analysis of soils, particularly the particles smaller than one micron in diameter and fine sand and silt. The method consists in shaking a dilute, fully deflocculated soil suspension in a cylindrical vessel, and determining the concentration as it changes with the time at measured distances below the surface. Method classifies the soil into fractions according to their rates

of fall, and Stokes' law is used to approximate the size of particles. Method offers a quantitative means of studying the flocculation phenomena and colloidal properties of soil.

JEPSON, H. G.

1. Prevention and control of gullies. *U. S. Dept. Agr. Farmers' Bul.* 1813, 59 pp., illus., Sept. 1939.
Provides general information on gully control. Describes the different types of gully treatment, and states the principles to be considered in employment of protective devices to control gully, also considers effective control measures in coordination with soil and water conservation practices. Describes damage by gullies and recommends bank protection on small streams by jetties wing dams, vegetation, cribbing or riprap, and channel straightening.
2. Farm ponds in soil and moisture conservation. *Soil Conserv.*, vol. 5, no. 4, pp. 77-82, illus., Oct. 1939.
Concerns the use of farm ponds to supplement water supplies during drought periods. Discusses employment of farm ponds, factors involved in their construction, and protection of ponds against silting.

JOACHIM, A. W. R.

1. (and Pandittesekere, D. G.). A soil erosion investigation. *Trop. Agr. [Ceylon]*, vol. 74, no. 4, pp. 200-203, Apr. 1930.
Report of observations to determine amounts of silt carried in the Mahaweli Ganga River at Gangoruwa, Ceylon, India. Presents data for surface and two-foot depth samples, surface velocity measurements, and rainfall in catchment area. Observation period, at intervals, was from Aug. 8, 1929 to Jan. 28, 1930. Estimates that amount of silt carried in water, at observation point, varies from about 130,000 to 820,000 tons per annum. Notes need for more extensive study on silt determinations in rivers of Ceylon, also on amounts of plant fertilizing constituents contained in water and suspended sediment.

JOGLEKAR, D. V. See also Framji, K. K., 1-44, 46; Inglis, C. C., 2, 4, 6, 9-21, 23, 25-33, 35-72; Anonymous, 127, 129.

1. (and staff at Khadakvasla). Causes of accretion of the river bed at Sukkur Barrage and how to reduce rate of rise. II. *Indian Waterways Expt. Sta., Poona, Res. Pub.* 10, pp. 59-66, illus., 1948.
Notes the courses of accretion of the river bed at Sukkur Barrage and recommends preventive measures. Gives data on silt loads.
2. (and staff at Khadakvasla). Design of the lower Sind Barrage: experiments to test the design for scour and sand exclusion from canals—Sind. *Indian Waterways Expt. Sta., Poona, Res. Pub.* 10, pp. 148-159, illus., 1948.
Describes model experiments to test the design of lower Sind Barrage for scour and sand exclusion from canals.
3. (and staff at Khadakvasla). Experiments in connection with dissipation of energy downstream of lower Sind Barrage of Hajipur. *Indian Waterways Expt. Sta., Poona, Res. Pub.* 10, pp. 10-11, 1948.
Gives the results of model experiments made in connection with energy dissipation downstream of lower Sind Barrage at Hajipur, India. The extent of scour was also determined.
4. (and staff at Khadakvasla). Experiments with a vertically-exaggerated model (1/400, 1/66) of the Mahanadi and its branches at Cuttack (Orissa). *Indian Waterways Expt. Sta., Poona, Res. Pub.* 10, pp. 19-22, 1948.
Reports model experiments concerned with flood control measures on the Mahanadi and its branches at Cuttack (Orissa). Various conclusions are given.
5. (and staff at Khadakvasla). Measures taken to control erosion of the left bank of the Rupnarain upstream of the Bengal Nagpur Railway Bridge at Kolaghat by means of a deflecting groyne. *Indian Waterways Expt. Sta., Poona, Res. Pub.* 10, pp. 5-7, illus., 1948.
Describes the field studies to control erosion of the left bank of the Rupnarain River at Kolaghat, India. A deflecting groyne was used to control bank erosion.

6. (and Inglis, C. C.). Methods followed in fixing model scale ratios and overcoming model limitations, based on experience gained at the Indian Waterways Experiment Station, Poona. Indian Waterways Expt. Sta., Poona, Res. Pub. 10, pp. 88-116, illus., 1948.

Describes methods followed in designing models and the carrying out of experiments in detail. Explains difficulties to be overcome and pitfalls to be avoided. Explains why some model experiments give reliable results and others depend on the making of correct assumptions. Describes the various types of models and gives specific examples of lock type. Various conclusions on the use of models are given.

7. (and staff at Khadakvasla). Protection of retaining walls from scour by means of repelling spurs (Baluchistan) (without model experiments). Indian Waterways Expt. Sta., Poona, Res. Pub. 10, p. 8, illus., 1948.

Notes briefly the use of repelling spurs to protect retaining walls from scour in Baluchistan.

8. (and staff at Khadakvasla). Scour downstream of rigid structures in wide channels. Indian Waterways Expt. Sta., Poona, Res. Pub. 10, pp. 67-71, illus., 1948.

Describes model experiments concerned with scour downstream of rigid structures in wide channels.

9. (and staff at Khadakvasla). Training of Jumna at Delhi Gate Pumping Station with pitched embankment on the right bank. Indian Waterways Expt. Sta., Poona, Res. Pub. 10, pp. 43-48, illus., 1948.

Describes model experiments concerned with the training of the Jumna River at the Delhi Gate Pumping Station.

10. (and staff at Khadakvasla). Training of Luni River to prevent it damaging Jodhpur Railway Line. Indian Waterways Expt. Sta., Poona, Res. Pub. 10, pp. 36-42, illus., 1948.

Describes various model experiments concerned with this problem.

11. (and staff at Khadakvasla). Training of the Malaprabha River to protect the left bank and abutment of the M. & S. M. Railway Bridge No. 8 at Hole Alur on the Hotgi Gadag Line. Indian Waterways Expt. Sta., Poona, Res. Pub. 10, pp. 7-8, illus., 1948.

Discusses very briefly the field results of measures adopted of model studies on the problem of training the Malaprabha River to protect the left bank and abutment of the M. & S. M. Railway Bridge No. 8 at Hole Alur on the Hotgi Gadag Line.

12. (and staff at Khadakvasla). Training the Hooghly River at Dunbar Cotton Mill with a by-pass channel. Indian Waterways Expt. Sta., Poona, Res. Pub. 10, pp. 11-18, illus., 1948.

Describes model experiments for training the Hooghly River at Dunbar Cotton Mill with a by-pass channel. The experiments were largely basic in character, because it was impracticable to construct a by-pass channel in the area under study.

JOHNSON, C. M. See Willis, E. A., 1.

JOHNSON, DOUGLAS.

1. Streams and their significance. Jour. Geol., vol. 40, no. 6, pp. 481-497, illus., Aug./Sept., 1932.

Presents a review of the classification of streams according to stages of development. Considers the classification of streams according to genesis. Presents a classification of streams with respect to genetically associated structures and with respect to structures not concerned with stream origin. Treats the classification of streams with respect to past changes of level. Treats such terms as subsequent streams, obsequent streams, resequent streams, insequent streams, misfit streams, and superimposed streams.

2. Origin of submarine canyons. Jour. Geomorph., vol. 1, no. 2, pp. 111-129; no. 3, pp. 230-243; no. 4, pp. 324-339; vol. 2, no. 1, pp. 42-60; no. 2, pp. 133-158; no. 3, pp. 213-236, Apr. 1938-May 1939.

Discusses hypotheses involving a tectonic origin and hypotheses of subaerial origin in-

volving a nontectonic origin. Discards hypotheses involving a tectonic origin; treats hypotheses of subaerial origin, of submarine origin, and of subterranean origin. Discusses evidence as to the existence of submarine landslides or mudflows. Deals with the nature of currents with reference to turbidity currents as a factor in the production of submarine canyons. Notes hypotheses involving currents, such as trenches on floors of lakes due to difference in density, temperature, and presence of sediment in water. The strength of the turbidity hypothesis on formation of submarine canyons by currents charged with suspended sediment is discussed. Comments on the effect of salinity on the deposition of fine sediment, and treats the flow of turbid water through reservoirs. Discusses the compaction, and porosity of sediments. Concludes by offering a hypothesis of submarine canyon development; the sapping action of artesian springs.

JOHNSON, E. N.

1. New river and harbor improvement projects. Military Engin., vol. 3, no. 9, pp. 30-51, Jan. 1911.

Describes principal river and harbor improvement projects in the United States, includes two paragraphs on shifting of bed and bank caving along the Mississippi below the mouth of the Ohio River. A survey in 1892 showed that about 1,000,000 cu. yd. per mile of bank annually fell into the river between Cairo and Donaldsonville, La., and measurements in 1908 showed 749 miles of caving banks between Cairo and the Red River. Notes use of submerged mattresses, with riprap bank protection above low water.

JOHNSON, HARLAN W.

1. A new apparatus for the mechanical analysis of soils. Soil Sci., vol. 16, no. 5, pp. 363-366, illus., Nov. 1923.

Presents a preliminary description of an apparatus for the mechanical analysis of soils patterned somewhat after Odén's balance; it draws the distribution curve itself.

JOHNSON, J. B.

1. Three problems in river physics. Amer. Assoc. Adv. Sci., Proc., vol. 33, sect. D, pp. 276-288, 1884.

Presents conclusions from investigations on the transportation of sediment and the formation and removal of sand bars, the flow of water in natural channels, and the effect of levees on floods and low water navigation of streams. Gives Mississippi River data. Discusses methods of sediment transportation, effect of changes in river stage upon conditions of erosion and the transportation and deposition of sediment, the mechanics of bed-load movement, factors affecting flow in natural channels, size and location of levees to confine floods, and effect of levees on stream-bed levels and upon low-water navigation.

2. Protection of the lower Mississippi Valley from overflow. Engin. News, vol. 23, no. 16, pp. 364-366, Apr. 19, 1890.

Discusses, in connection with the protection of the lower Mississippi Valley from floods, phenomena related to the use of levees, noting in particular conditions of stream erosion and the transportation and deposition of sediment. Stresses the inefficiency of the levee system and recommends that the present system be maintained as a protection against normal floods and that weirs be constructed to control exceptional floods.

JOHNSON, JOE W. See also Bermel, K. J., 1; Chang, Y. L., 1; Dobson, G. C., 3; Einstein, H. A., 2, 4; Fry, A. S., 2; Griffith, W. M., 2; Kalinske, A. A., 10; Kirkham, D., 1; Putman, J. A., 1; Rouse, H., 1; Stevens, J. C., 6; Witzig, B. J., 1; Zwerner, G. A., 2.

1. Notes on the accuracy of movable-bed hydraulic models. Civ. Engin., vol. 8, no. 6, pp. 410-411, illus., June 1938.

Discusses various notes on the accuracy of movable-bed model studies. Considers the application of statistical methods to results of a point-by-point comparison of soundings over

- model beds; the comparative accuracy of reproducing bed configurations in an overflow-dam model and a movable-bed model; the sounding differences in models with fixed and easily erodible banks; the formation of riffles as an obstacle in the interpretation of movable-bed model studies; bed material for movable-bed models; and factors which may limit the value of results in models when applied to the prototype.
2. Transportation of sediment by streams; bed load. 9 pp. Washington, U. S. Soil Conserv. Serv., 1939.
Report for the round table discussion on "The Role of Hydraulic Laboratories in Geophysical Research," at the National Bureau of Standards, Sept. 13, 1939, relative to laboratory studies of bed-load movement. Discusses previous experiments conducted to determine the critical tractive force, rate of bed-load transportation in flumes, quantitative field measurements of bed-load transportation. Reviews attempts to determine relation between the roughness coefficient of particle size, and other peculiarities of the bed load. Outlines studies involving the design of non-silting channels in erodible materials, the phenomenon of local scour, sorting of river sediments, beach erosion, scour in sandy river beds, and riffle formations and bed configurations. Notes that previously conducted bed-load investigations are now being maintained at several American laboratories. Outlines an intensive study of the relation of sediment load to the hydraulic and physical factors of a stream now in progress at the U. S. Soil Conservation Service laboratory on the Enoree River, near Greenville, S. C. Recommends that future bed-load movement research be conducted along bearings set down by writer. Provides an extensive reference list.
 3. The transportation of sediment by flowing water. 25 pp., illus. Washington, U. S. Soil Conserv. Serv., Sedimentation Div., Off. Res., 1940.
Paper presented at a colloquium, Dept. of Civil Engineering, Columbia University, New York, N. Y., Dec. 5, 1939. Discusses the movement of sediment in defined channels. States that the purpose of investigations on sediment transportation is to obtain basic data relative to the magnitude and nature of a particular stream and to determine the principles governing the sedimentary characteristics of any river. Results of laboratory and field investigations on bed-load and suspended-load transportation are summarized.
 4. The transportation of sediment by flowing water and its importance in soil conservation. Soil Conserv., vol. 6, no. 11, pp. 290-293, illus., May 1941.
Considers the various aspects of sediment transportation in that zone of a drainage basin in which stream erosion is a major factor. Distinguishes between and describes the characteristics of suspended and bed loads of a stream; notes factors affecting their magnitude and movement. Notes that to determine sources of sediment and to plan effective measures to prevent sedimentation damage on a drainage basin, knowledge of both the quantity and quality of the sediment load of the stream is required. Briefly considers conditions of sediment deposition in reservoirs, silt flowing out of reservoirs, and the phenomenon of density currents in a reservoir. Conditions of sedimentation in Lake Issaqueena, near Clemson, S. C., on Aug. 21 and Oct. 31, 1940, are described to indicate the utility of sluice gates near the base of the dam to discharge water containing high sediment concentrations. Stresses the need of erosion control practices on the land of a drainage basin in order to reduce the rate of reservoir silting.
 5. (and Brown, Hugh A.). Principles affecting the control of erosion in road cuts and roadside ditches. Soil Conserv., vol. 7, no. 6, pp. 138-140, illus., Dec. 1941.
Discusses the principles affecting the control of roadside gully erosion. Conclusions expressed in this article were derived from a brief study of the character of erosion and transportation of erosional debris to Lake Issaqueena, near Clemson, S. C.
 6. The importance of considering side-wall friction in bed-load investigations. Civ. Engin., vol. 12, no. 6, pp. 329-331, illus., June 1942.
Discusses bed-load formulas and the failure to eliminate the influence of side walls in certain studies. The studies summarized include effects of temperature and viscosity.
 7. Underflow studies at Lake Issaqueena. Civ. Engin., vol. 12, no. 9, pp. 513-516, illus., Sept. 1942.
Gives information on the frequency of occurrence of underflows, and on the amount of sediment that may be vented by their proper utilization. The operation of sluice gates during flood time has proved effective. Points out the need for quick and convenient control of gates to draw off the turbid underflow.
 8. Distribution graphs of suspended-matter concentration. Amer. Soc. Civ. Engin. Trans., vol. 108, pp. 941-956, illus., 1943; also in Amer. Soc. Civ. Engin., Proc., vol. 68, no. 8, pp. 1383-1398, illus., Oct. 1942.
Discusses the determination of the total load of the stream and also the relative proportions of fine and coarse material because different types of damage are caused in different proportions by these two classes of sediment. Flood and drainage damage are due to deposition of coarse material and are a bed-load problem. Deposition in irrigation canals, reservoirs, and water-purification plants consists mainly of fine material, but a part of the load in reservoirs is also coarse. Outlines a method of calculating the total suspended load of fine material transported during a particular stream rise by using a distribution graph of suspended-matter concentration in connection with the observed hydrograph and a single observed suspended-matter concentration.
Discussion: HANS ALBERT EINSTEIN, pp. 957-958, notes value of the method for obtaining a record of suspended load. Comments on the concept of "time-of-lead." The application of the unit-graph method to streams with large and complex watersheds needs further study. GILBERT C. DOBSON, pp. 958-959, considers the relation between discharge and load of suspended sediment. Notes the importance of the time factor of transportation of the fine and coarse sediments, because any measures which would prevent the fine sediment, wash load, from entering a stream would be immediate and beneficial in their effect. THOMAS R. CAMP, pp. 959-960, comments on the mechanics of sediment transport; notes that the entire process of transportation of sediment in order to continue depends on scour. States that a study is needed in order to obtain a better understanding of the hydraulic conditions governing the rate of scour. FRANK S. BAILEY, p. 960, notes briefly the value of Professor Johnson's method of obtaining suspended-load determinations. THE AUTHOR, pp. 960-964, notes that the study deals with the transportation of fine materials in small streams in a humid climate only. Treats various points brought out by the discussers. Comments on the use of turbidity determinations for determining the wash load of a stream. Points out that the average annual contribution of bed load can be made from the use of a suitable bed-load formula and a flow-duration curve. Points out that it may be possible with long-term records to obtain a relationship between annual suspended load and annual runoff.
 9. The use of mass-curves in evaluating suspended-load observations on small Piedmont streams. Amer. Geophys. Union, Trans., vol. 23, pt. 2, pp. 664-672, illus., Nov. 1942.
Discusses the relationship between suspended load of Piedmont streams and total rainfall, presenting the extrapolation of data by means of mass-curves and an average slope-ratio. Discussion: S. K. LOVE, p. 672, states that the mass-curve method may be useful in evaluating sediment loads in streams having small drainage areas.
 10. Laboratory investigations on bed-load transportation and bed roughness. U. S. Soil Conserv. Serv., SCS-TP-50, 116 pp., illus., Mar. 1943.

- A report which presents basic experimental data on sediment transportation. Comments on the use of Du Boy's equation, the Schoklitsch-Gilbert type of formula, and Einstein's bed-load function. Summarizes the basic hydraulic and sedimentary data from all available published and unpublished flume experiments and presents them in a uniform and consistent system of units. Gives also a brief description of experimental equipment and procedure. Reports compilation of published and unpublished data on laboratory investigations on bed-load transportation and bed roughness. Discusses experiments by the following: G. K. Gilbert, C. H. MacDougall, S. D. Chyn, A. L. Jorissen, U. S. Waterways Experiment Station, Chitty Ho, Yun-Cheng Tu, T. Y. Lui, A. N. Carter, J. Bogardi, C. H. Yen, M. P. O'Brien, C. A. Wright, J. Schaffernak, E. Meyer-Peter, Hans Kramer, H. J. Casey, A. Shields, Pang-Yung Ho, Y. L. Chang, E. Indri, and H. Nakayama. Contains a bibliography of 48 articles dealing with the subject.
11. (and Minaker, W. L.). Movement and deposition of sediment in the vicinity of debris-barriers. *Amer. Geophys. Union, Trans.*, 1944, pt. 6, pp. 901-905, May 1945.
Discusses problems of sediment movement and deposition in the vicinity of debris-barriers. Considers laws of transportation and deposition of sediment and the relation to scour and fill.
- JOHNSON, OLIVER. See Coldwell, A. E., 2.
- JOHNSON, R. C. See Lane, E. W., 4.
- JOHNSTON, C. T.
1. Report of irrigation investigations for 1900—Discussion of investigations. U. S. Off. Expt. Sta. Bul. 104, pp. 21-59, illus., 1902; [abstract], *Engin. News*, vol. 48, no. 12, p. 208, Sept. 18, 1902.
Includes the description of a water sample trap used in silt investigations and its mode of operation. Notes means of making sides and bottoms of canals impervious by a coating of silt. Discusses silt investigations undertaken by J. C. Nagle (Report of Irrigation Investigations for 1899), noting the effect of reduced storage capacity of reservoirs due to silting and its effect on irrigation. Observations on the Rio Grande show that water almost loses its character owing to the amount of silt it contains. Samples collected from principal streams of Texas and a study of the reservoir system of New Mexico indicate that there is no relation between the percentage of silt in water and the discharge of stream or color of water. Notes means of silt disposal by settling basins.
- JOHNSTON, EDWARD C. See Sumner, F. B., 1.
- JOHNSTON, NORRIS.
1. (and Howell, Lynn G.). Sedimentation equilibria of colloidal particles. *Phys. Rev.*, vol. 35, pp. 274-282, illus., Feb. 1, 1930.
Describes results of an investigation of the La Place-Perrin Law of the Distribution of Suspensions. Discusses the problem of sedimentation equilibrium of colloidal particles in deep cells.
- JOHNSTON, W. A.
1. Sedimentation of the Fraser River Delta. *Canada Geol. Survey, Mem.* 125, 46 pp., illus., 1921.
Presents results of a study on conditions of sedimentation in the Fraser River Delta, Canada. Data are given on sediment transported by the stream; dissolved and suspended load determinations (1919-20), mechanical analysis of suspended material, bed-load characteristics, water density and temperature, and effects of sea water on deposition in the stream; characteristics of delta river, and sea bottom material; changes in river channel; and rate of advance of the delta. Conclusions regarding the characteristics of the river and difficulties of maintaining adequate navigable depths in certain places are given.
 2. The age of the Recent Delta of Fraser River, British Columbia, Canada. *Amer. Jour. Sci.*, vol. 1, no. 5, pp. 450-453, May 1921.
Presents a general description of the Recent Delta of the Fraser River and describes studies

by the Geological Survey of Canada relative to the age of the delta. Includes one paragraph noting the average rate of advance of the delta, as a whole, of approximately 10 ft. per yr.

3. The character of the stratification of the sediments in the Recent Delta of Fraser River, British Columbia, Canada. *Jour. Geol.*, vol. 30, no. 2, pp. 115-129, illus., Feb./Mar. 1922.

Results of an investigation during parts of 1919 and 1920 dealing with the character and mode of origin of the stratification of the sediment in the Recent Delta of the Fraser River, British Columbia, Canada and comparing the character of the stratification of the deposits forming in fresh water with that of the deposits forming in salt water.

JONAH, F. G. See Blaess, A. F., 1.

JONES, ARTHUR TABER.

JONES, B. E.

1. Grazing control stops no floods [letter to editor]. *Civ. Engin.*, vol. 3, no. 6, pp. 333-334, June 1933.
Comments on the Influence of Overgrazing on Erosion and Watersheds (Chapman, H. H., 5). Silting of Arrowrock Reservoir with a loss of 6 percent of capacity was due in part to wave action on the borders and placer mining on the south and middle forks of Boise River. The watershed of Boise River is in a National Forest but nevertheless is a source of silt. Discusses floods in Manti, Ephraim and Six Hill Canyons in relation to rainfall and vegetative cover. Overgrazing as a cause of erosion is not proven.

JONES, B. E.

1. Grazing control stops no floods [letter to editor]. *Civ. Engin.*, vol. 3, no. 6, pp. 333-334, June 1933.
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JONES, D. M.

JONFS, R. See also Clyde, G. D., 1.

JONES, F. R.

1. (and Barlow, C. G.). Sedimentation analysis, an improved manometric method. *Soc. Chem. Indus. Jour.*, Trans. and Commun., vol. 62, no. 9, pp. 129-132, Sept. 1943.
Describes an apparatus for sedimentation analysis which avoids the need for a long manometer for measuring the slight change of pressure caused by solid particle subsidence in a liquid medium. Notes that duplicate analyses can be made without filling the sedimentation tube.

JONES, FRANK L.

tion and common sedimentation methods were used, and the advantages of the microprojection method were noted.

JONES, HOWARD F.

1. Growing forage on mill pond land and red land [letter to editor]. *South. Planter*, vol. 69, no. 5, pp. 500-502, May 1908.

Requests information relative to the agricultural value of silt deposits left when the 50-yr. old dam of Shocco Mills broke. The editor recommends liming, deep plowing, and planting several types of sorghum.

JONES, JAMES T.

1. On cutting down and cleaning up the margins of rivers [letter to editor of *Virginia Farmer*]. *South. Agr.*, vol. 6, no. 12, pp. 648-650, Dec. 1833.

Advocates cutting of vegetation along creeks and rivers to prevent bank erosion and suggests a method of straightening creeks and branches.

JONES, LEWIS A.

1. (and Schlick, W. J., and Ramser, C. E.). A report of the methods and costs of reclaiming the overflowed lands along Big Black River, Mississippi. U. S. Dept. Agr. Bul. 181, 39 pp., illus., Apr. 12, 1915.

Briefly describes conditions found, discusses the drainage problems encountered, and presents a plan of drainage considered most practicable for the reclamation of overflowed lands along the Big Black River, Mississippi. Includes four paragraphs in which writers stress the necessity of providing sedimentation areas at the lower extremities of the several tributaries of the river, and of taking immediate steps to arrest hillside erosion to prevent sedimentation in drainage channels.

JONES, PAUL A. See Grover, N. C., 12.

JONES, ROY W.

1. Observations on the effects of erosion on the ecology and maintenance of an artificial lake in Logan County, Oklahoma. *Okla. Acad. Sci., Proc.*, vol. 19, pp. 37-38, 1938.

Discusses the effects of stream erosion below the dam and of watershed erosion above it upon ecological conditions within the lake and below it.

JONES, VICTOR H. See also Brown, C. B., 35; Glymph, L. M., Jr., 1-6; Gottschalk, L. C., 12; Lane, E. W., 22.

1. Contributions to the Mississippi Delta by sediments from Red River [abstract]. *Geol. Soc. Amer. Bul.*, vol. 41, no. 1, p. 165, Mar. 1930.

Paper presented at a joint session of Section E of the American Association for the Advancement of Science and the Geological Society of America, Dec. 30, 1929. Paper contains the results of observations relative to Red River sediments contributions to the Mississippi Delta.

2. Sedimentation in Red River below the mouth of Washita River. *Iowa Univ. Studies in Nat. Hist.*, vol. 15, no. 4, 30 pp., illus., tables and graphs, Nov. 15, 1933.

Explains briefly the relation of the Red River to the sediments of the Mississippi. Much of the sediment from the Red River mixes with sediment from the Old River and becomes a part of the Atchafalaya deposits; little sediment enters the Mississippi. Classifies the Red River sediment under 5 heads: muds, channel sands, chute deposits, lag materials, and pudding sands. Gives results of mechanical analysis of the sediments. Considers the sources of sediments and points out that the bulk of coarse material travels a relatively short distance.

3. Advance report on the sedimentation survey of Lake Bracken, Galesburg, Illinois. U. S. Soil Conserv. Serv., SCS-SS-14, 10 pp., illus., May 1937.

A sedimentation survey, conducted during the period July 9 to Aug. 15, 1936 at Lake Bracken, located on Brush Creek, 5 1/2 miles south of Galesburg, Ill., revealed that the reservoir had lost 7.67 percent of its original capacity due to silting since its completion in Dec. 1923. The annual average depletion amounted to 0.60 percent. Accumulations in the original 2,881

acre-foot reservoir amounted to 221 acre-feet after 12.7 yr. of operation. The average annual accumulation amounted to 17.4 acre-feet. The lake sediment is chiefly derived from the loess and loess-derived soils which cover most of the watershed. Localized erosion in gullies and on slopes contribute most of the silt deposited in Lake Bracken. Life expectancy of reservoir is 150 yr., however, rigorous soil conservation measures applied to most severely eroding parts of watershed would more than double the life expectancy of the lake. Report includes detailed data pertaining to engineering features of dam and reservoir, character of watershed, and character, distribution, and origin of sediment in the lake.

4. Advance report on the sedimentation survey of West Frankfort Reservoir, West Frankfort, Illinois. U. S. Soil Conserv. Serv., SCS-SS-15, 9 pp., illus., May 1937.

A sedimentation survey conducted during the period Aug. 19 to Sept. 12, 1936, at West Frankfort Reservoir, a municipal water supply reservoir, located on Tilley Creek, 6 miles east of West Frankfort, Ill., revealed that the reservoir had lost 8.09 percent of its original capacity due to silting since its completion in August 1926, which amounted to an average annual depletion of 0.81 percent. Total accumulation in the original 1,175 acre-foot reservoir amounted to 95 acre-feet during 10.0 yr. of operation, an average annual accumulation of 9.5 acre-feet. Of the total watershed area of 3.79 sq. miles, 30 percent is forest, 50 percent pasture, and 20 percent cultivated land. Sediment in reservoir is derived chiefly from sheet and gully erosion of the unprotected portion of the loess and loessial soils of the watershed. Report includes detailed data pertaining to the engineering features of the dam and reservoir, character of watershed, and character, distribution, and origin of the reservoir deposits.

5. Advance report on the sedimentation survey of Baker Reservoir, Baker, Montana. U. S. Soil Conserv. Serv., SCS-SS-21, 15 pp., illus., July 1938.

A sedimentation survey conducted during the period May 24 to June 6, 1937, at Baker Reservoir, located on Sandstone Creek, at Baker, Mont., revealed that 33.60 percent of the reservoir's original capacity had been lost due to sediment accumulations since its completion in May 1908. The average annual depletion was 1.15 percent. The original reservoir capacity of 756 acre-feet was reduced to 502 acre-feet after 29.1 yr. of operation. The average annual accumulation amounted to 8.7 acre-feet. Lake sediment is chiefly derived from sheet erosion during infrequent rainstorms on the 5.2 sq. miles of watershed. Overgrazing and attempted cultivation of land during drought years serves to accelerate watershed erosion and reservoir silting. Possibilities for sediment removal from reservoir by hydraulic means are considered. Rate of sedimentation in reservoir indicates that the time required to remove 1 in. of soil from entire basin is about 61 yr. Report includes detailed data pertaining to the engineering features of the dam and reservoir and to the character, distribution, and origin of the reservoir deposits.

6. Advance report on the sedimentation survey of Lake Eldorado, Eldorado, Kansas. U. S. Soil Conserv. Serv., SCS-SS-25, 13 pp., illus., July 1938.

A sedimentation survey made during the period Apr. 20 to May 8, 1937 at Lake Eldorado, a municipal water supply and recreational reservoir, located on Satchel Creek 4.7 miles northeast of Eldorado, Kans., revealed that the 3,213-acre-foot reservoir had lost, due to silting 4.08 percent of its original capacity since its completion in Apr. 1928. The average annual depletion amounted to 0.45 percent. Total deposits in reservoir after 9.0 yr. of operation amounted to 131 acre-feet, an average annual accumulation of 14.6 acre-feet. Of the total watershed area of 33.0 sq. miles, 20 percent is cultivated, 5 percent is woodland, and 75 percent is grazing land. Reservoir sediment is

chiefly derived from sheet erosion along slopes of Satchel Creek Valley and erosion of alluvium along stream banks above the lake. Report includes detailed data pertaining to the engineering features of the dam and reservoir, character of watershed, and character, distribution, and origin of reservoir deposits.

7. Advance report on the sedimentation survey of Lake Olathe, Olathe, Kansas. U. S. Soil Conserv. Serv., SCS-SS-24, 13 pp., illus., July 1938.

A sedimentation survey conducted during the period May 26 to June 4, 1937, at Lake Olathe, an auxiliary municipal water supply and recreational reservoir, located on Cedar Creek, 3 miles southwest of Olathe, Kans., revealed that the lake had lost, since its completion on July 4, 1932, 10.34 percent of its original capacity of 532 acre-feet due to silting. This amounted to an average annual depletion of 2.11 percent. Total deposits in lake during 4.9 yr. of operation amounted to 55 acre-feet, an average annual accumulation of 11.2 percent is cultivated land, 27 percent pasture, and 1 percent railroad property. The area is subject to sheet erosion. Stresses need for erosion-control practices over entire drainage area. Report includes detailed data pertaining to engineering features of the dam and reservoir, character of watershed, and character, distribution, and origin of reservoir sediment.

8. Advance report on the sedimentation survey of Mission Lake, Horton, Kansas. U. S. Soil Conserv. Serv., SCS-SS-22, 15 pp., illus., July 1938.

A sedimentation survey conducted during the period Apr. 15 to May 6, 1937, at Mission Lake, a municipal water supply reservoir, located on Mission Creek, 0.7 mile northeast of Horton, Kans., revealed that the reservoir had lost due to sediment accumulations, 15.60 percent of its original capacity since its completion in May 1924. The average annual depletion in storage amounted to 1.20 percent. Total original storage of 1,852 acre-feet was reduced to 1,563 acre-feet after 13.0 yr. of operation. The average annual accumulation amounted to 22.2 acre-feet. Of the 11.4 sq. miles of drainage area, 77 percent is cultivated, 21 percent is pasture, 1 percent is in timber, and 1 percent is urban areas. Sheet and gully erosion on watershed are chief factors involved in the silting of the reservoir. Rate of reservoir sedimentation indicates that the maximum time required to remove 1 in. of soil from watershed area is about 30 yr. Notes that some sediment entering reservoir has been carried through the lake and over the spillway crest. Silt trap basins behind road fills have prevented some sediment from reaching the lake, and park facilities being established will further retard deposition. Stresses need for erosion control and protective measures on watershed. Report includes detailed data pertaining to the engineering features of the dam and reservoir, character of watershed, and character, distribution, and origin of sediment in the reservoir.

9. Advance report on the sedimentation survey of Wellfleet Reservoir, Wellfleet, Nebraska. U. S. Soil Conserv. Serv., SCS-SS-23, 16 pp., illus., July 1938.

A sedimentation survey conducted during the period May 10 to 19, 1937, at Wellfleet Reservoir, a recreational development, located on Medicine Creek, one-fourth mile west of Wellfleet, Nebr., revealed that the reservoir had lost 10.60 percent of its original capacity of 519 acre-feet due to silting since its completion in October 1931, an average annual depletion of 1.89 percent. Total deposits in reservoir after 5.6 yr. of operation amounted to 55 acre-feet, an annual average accumulation of 9.8 acre-feet. Of the 43 sq. miles of drainage area, 22 percent is crop land, 2 percent farmsteads and gardens, 29 percent idle land (chiefly sand dunes), and 47 percent grazing land. Greater part of sediment in reservoir originates in southeastern portion of watershed area where gullying is active. Wind action in the dune area also contributes to the reservoir sediment. Soil

conservation measures to stabilize gullies and reduce runoff from agricultural areas and to stabilize sand dunes would materially decrease silting rate of reservoir. The development of grass and trees on gully and valley bottoms and stream banks would tend to increase deposition, and thereby retain much sediment which would otherwise enter the reservoir. Grass and trees would also protect existing alluvial deposits and the stream banks against erosion by flood waters. Report includes detailed data pertaining to the engineering features of the dam and reservoir, general character of the watershed, and character, distribution, and origin of reservoir sediment.

10. Sedimentation in Herrin Reservoir No. 2, Illinois, from 1926 to 1935 [abstract]. Wash. Acad. Sci. Jour., vol. 28, no. 9, p. 420, Sept. 15, 1938.

Presents results of a sedimentation survey conducted May 12-13, 1936, by the Section of Sedimentation Studies, U. S. Soil Conservation Service, at Herrin Reservoir No. 2, Ill. Brief outline of the construction details and history of the lake are given. Failure of dam on June 20, 1935 revealed complete sedimentary history of the Lake. Data on distribution of sediment in reservoir are given.

11. Causes and effects of channel and floodway aggradation. Fed. Inter-Agency Sedimentation Conf., Denver, 1947, Proc., pp. 168-178, illus., 1948.

Describes problem of channel and floodway aggradation as a reflection of accelerated modern erosion rates. Defines accelerated aggradation which refers to modern increases in stream and valley sedimentation rates under cultural influences as contrasted to normal geologic rates. Lists ten chief effects of accelerated alluvial deposition. Describes accelerated alluvial deposition in four typical valleys. Explains difficulties of evaluating accelerated deposition in areas of clay and silt soils and in relation to underlying rock formations. Discussion: ROBERT C. LORD, pp. 178-180, comments on sedimentation problems of the middle Rio Grande area in New Mexico. Notes briefly the rock formations, geologic history, climate, and sedimentation damages, etc. STAFFORD C. HAPP, pp. 180-184, notes various features of soil erosion. Instances of channel aggradation are pointed out. Degradation is also considered.

JORDAN, DAVID STARR.

1. Report of explorations in Colorado and Utah during the summer of 1889, with an account of the fishes found in each of the river basins examined. U. S. Fish Comn. Bul., vol. 9, pp. 1-40, illus., 1889.

Presents an account of the various species of fish found in the river basins of Colorado and Utah and considers the factors which influence fish life in the streams. The effects of silt, placer-mining and stamp-mill debris, and irrigation practices on fish life in streams are briefly considered.

JORDANA, JORGE.

1. El pantano de La Pena en 1924 (La Pena Reservoir in 1924). Rev. de Obras Publicas, vol. 73, no. 2420, pp. 39-42, 1925; [abstract], Engineer [London], vol. 139, no. 3612, p. 320, Mar. 20, 1925. Describes the sluicing arrangement at the Pantana de la Pena reservoir, located on the Gallego River, Spain. Effect of sluicing arrangement was not only to remove the silt, but also to scour and enlarge the bed of the reservoir thereby increasing its capacity.

JORISSEN, ANDRE.

1. Experimental study of bed-load transportation in river channel. 64 pp., tables and graphs, June 20, 1936. Unpublished thesis (M. S.) - Massachusetts Institute of Technology.

Discusses experiments which will help in eventually determining rates of movement and critical tractive forces for bed load of full-scale rivers and relationships between this phenomenon and the results of flume investigations. Two different sand mixtures were studied as to the extent that the mechanical composition and compaction affect the bed-load transportation capacity. Gives a resumé of various researches and sand transportation in river channels. Describes apparatus used, procedure, and results.

2. Etude experimentale du transport solide des cours d'eau (Experimental work of transportation of solids by streams). Rev. Univ. des Mines, (ser. 8) vol. 14, no. 3, pp. 269-282, Mar. 1938. In French. Translation on file at the U. S. Soil Conservation Service, Washington, D. C.
Gives the points of view of some characteristic studies made on the transportation of material on stream beds. Deals with a number of theoretical considerations on this subject and shows their importance as examples for experimental work. Gives the results of tests in the form of diagrams. Introduces certain laws of transportation which are generally applicable for the same type of tests.
- JURINA, VIKTOR.**
1. Der Donaudurchstich bei Wien und seine Geschiebeverhältnisse (The Danube cut at Vienna and its bed-load conditions). Wasserwirtsch. u. Technik, vol. 4, no. 31-33, pp. 296-305, illus., Nov. 15, 1937; [abstract], Civ. Engin., vol. 9, no. 2, p. 20, Feb. 1939. In German. Translation on file at the U. S. Soil Conservation Service, Washington, D. C.
Review of studies of bed-load conditions of a regulated section of the Danube River at Vienna. Gives a determination of coefficient of silt transportation.
- JURITZ, C. F.**
1. Orange River silt as a fertilizing agent. Agr. Jour. Cape of Good Hope, vol. 31, no. 3, pp. 395-399, Sept. 1907.
Explains that the fertility of silt is due to its chemical constituents and mechanical condition and notes that the productiveness of the soil is subject to variable environmental conditions. Points out that the fertility of soil in Oudtshoorn and Britstown divisions is enhanced by rich alluvial deposits. Gives chemical and mechanical analyses and describes prevailing environmental conditions at site where silt samples were taken from the Orange River bed. Calls attention to the pecuniary and chemical content or fertilizing values of the silt deposits.
- JUSTIN, JOEL D.** See Campbell, F. B., 1.
KADIE, CARL H. See Campbell, F. B., 1.
KALINSKE, A. A. See also Dobbins, W. E., 1; Einstein, H. A., 4; Krumbein, W. C., 29; Lane, E. W., 9, 16; Van Driest, E. R., 2; Vanoni, V. A., 1, 4.
1. (and Van Driest, E. R.). Application of statistical theory of turbulence to hydraulic problems. Internatl. Cong. Appl. Mechanics, 5, pp. 416-421, illus., 1938.
Discusses the application to natural turbulent water streams of the statistical theory of turbulence as developed by Taylor and as expanded by Von Karman. Notes that the diffusion characteristics of turbulence are essential to the study of sediment transportation in streams.
 2. Relation of statistical theory of turbulence to hydraulics. Amer. Soc. Civ. Engin., Trans., vol. 105, pp. 1547-1566, illus., 1940; also in Amer. Soc. Civ. Engin., Proc., vol. 65, no. 8, pp. 1387-1406, illus., Oct. 1939.
Correlates the knowledge of fluid turbulence with the solution of some practical hydraulic problems. Defines turbulence. Presents in a simplified form existing information on fluid turbulence and experimental data obtained by the writer and others. Discusses various experimental techniques for obtaining pertinent information on liquid turbulence. The relation of turbulence research to hydraulic problems involving increase or decrease of energy dissipation, and the transportation of sedimentary materials is considered.
Discussion: HUNTER ROUSE, pp. 1567-1568, summarizes the items in Kalinske's paper which relate to hydraulic problems. MARTIN A. MASON, pp. 1568-1571, briefly points out several concepts included in Kalinske's paper. States that the present statistical theory of turbulence does not offer an immediate possibility of application to hydraulic problems since it is concerned chiefly with isotropic turbulence. Notes various other photographic techniques that have been used and suggested for studying turbulence. J. C. STEVENS, pp. 1571-1572, comments on the author's treatment of energy losses as heat dissipation through viscous properties of water in turbulent motion. BORIS A. BAKHMETEFF, pp. 1572-1574, makes various remarks dealing with turbulence. CLYDE W. HUBBARD, pp. 1574-1576, treats of tests with pitot tubes. JOHN S. NENOWN, pp. 1576-1578, mentions that turbulence must be considered in studies dealing with bed-load transportation. SAMUEL SHULITS, pp. 1578-1580, deals with the significance of statistical fundamentals, the diffusion coefficient, and phases in the development of hydraulics and fluid mechanics. PAUL NEMENYI, pp. 1581-1591, shows the retardation of flow in conduits having various types of boundary obstacles. Considers the application of the theories of turbulence to problems of sediment transportation. BENNIE N. NETZER, pp. 1591-1593, describes a helical spring dynamometer for measuring velocities in a region of turbulent flow. THE AUTHOR, pp. 1593-1600, comments on the above mentioned discussions.
3. Experimental studies of liquid turbulence. Iowa Univ. Studies in Engin., Bul. 20, pp. 50-65, illus., Mar. 1940.
Presents a proper concept of turbulence which can be applied quantitatively and can be of practical use. Gives experimental data on the measurement of velocities in turbulent flow obtained by motion picture photography. The methods used are described. Methods and results of determinations of the coefficient of diffusion for turbulence are given; notes that this parameter is of importance in the study of the relation of suspended material concentration and turbulence. Considers the energy of turbulence as the form of kinetic energy present in turbulent flow. States that if energy dissipation and transformation in a turbulent flow is to be studied, the energy of turbulence must be calculated.
 4. Suspended-material transportation under non-equilibrium conditions. Amer. Geophys. Union, Trans., vol. 20, pt. 2, pp. 613-617, illus., July 1940.
Analyzes and studies the problem of suspended-material transportation for non-equilibrium conditions making use of knowledge relating to the transportation of suspended material for equilibrium conditions. Discusses the conditions causing increase or decrease in suspended load. Develops the differential equation which controls the phenomena of suspended-material transportation under non-equilibrium conditions. Presents an approximate solution of the differential equation by the method of finite increments.
 5. Investigations of liquid turbulence and suspended material transportation. In Pa. Univ. Bicentennial conf. Fluid mechanics and statistical methods in engineering, pp. 41-54, illus. Philadelphia, Univ. Pa. Press, 1941.
Discusses the mechanism of turbulence and its relation to the transportation of suspended matter. Considers such subjects as general theory of diffusion in a turbulent fluid, theory of suspended-material transportation in an open water channel, and the relation between suspended material and bottom composition. Notes that the most important item which needs laboratory study is the mechanism of the placement of sediment in suspension in the bottom region.
 6. (and Robertson, J. M.). Turbulence in open channel flow. Engin. News-Rec., vol. 126, no. 15, pp. 53-55, illus., Apr. 10, 1941.
Presents a general theory of diffusion in turbulent flow and gives results of hydraulic laboratory studies in which direct quantitative measurements of turbulence diffusion were made. Data obtained are applied to problems involving sediment transportation in open channels.
 7. Criteria for determining sand-transport by surface-creep and saltation. Amer. Geophys. Union, Trans., vol. 23, pt. 2, pp. 639-643, Nov. 1942.
Presents an expression for the critical tractive force necessary to initiate sand-movement, and indicates how this tractive force in non-turbulent fluid-streams can be determined under controlled laboratory conditions. States that the

- instantaneous rate of sand-grain movement depends on the difference between fluid velocity at the instant and the critical velocity. Develops an expression for the maximum height of sand-particle "bounce" in terms of grain-diameter in order to make an analysis of the criterion for saltation.
- Discussion:** HANS ALBERT EINSTEIN, p. 643, reviews the assumptions put forth by Kalinske. Einstein notes that initial movement is theoretically unimportant; and that Kalinske reveals saltation to be unimportant as a way of transportation in water.
8. The role of turbulence in river hydraulics. Iowa Univ. Studies in Engin. Bul. 27, pp. 266-279, illus., 1943.
Notes that the movement of bed load and suspended matter is more or less the results of the action of turbulent eddies. Analyzes and presents data regarding the characteristics of turbulence in rivers and open channels.
 9. Turbulence and the transport of sand and silt by wind. N. Y. Acad. Sci. Ann., vol. 44, pp. 41-54, illus., May 29, 1943.
Discusses sand and silt transport by surface creep (bed-load movement) saltation, and suspension. Considers the initial movement of sand grains. Treats turbulence and diffusion and distribution of suspended material. Gives a formula which controls the phenomenon of the suspension problem; the suspension problem being treated as a diffusion phenomenon on which gravity is superimposed.
 10. (and Pien, C. L.). Experiments on eddy-diffusion and suspended-material transportation in open channels. Amer. Geophys. Union, Trans., vol. 24, pt. 2, pp. 530-535, illus., Jan. 1944.
Results of a study concerned with direct measurements of eddy-diffusion coefficients and suspended-material concentrations in order to gain a better understanding of the fundamental mechanics of suspended-material transportation by turbulent flow in open channels.
Discussion: J. W. JOHNSON, p. 536, states that the author's data verify the theory of vertical distribution of suspended sediment in a turbulent stream. Notes the purpose of investigations on the distribution of suspended sediment is to develop a procedure for estimating total suspended load. Makes various other pertinent remarks concerning the problem.
 11. (and Hsia, C. H.). Study of transportation of fine sediments by flowing water. Iowa Univ. Studies in Engin. Bul. 29, 30 pp., tables and graphs, 1945.
An investigation to obtain information on the movement of very fine sediments in suspension in the flowing water of a rectangular flume. Silica which had a median diameter of 0.011 mm. and a specific gravity of 2.67 was used. Treats the hydraulic character of stream flow, and gives data for 9 discharges regarding the concentrations of suspended sediment and bed composition. Notes the development of a relationship between the bed composition and the amount of material in suspension for given hydraulic conditions in an open-water channel. Treats velocity and sediment transportation.
 12. Application of statistical theory to measurements of velocity and suspended sediment in rivers. Amer. Geophys. Union, Trans., vol. 26, no. 2, pp. 261-264, Oct. 1945.
A report, the purpose of which is to apply the statistical theory of random sampling to obtain a proper mean measure of velocity or suspended sediment concentration in a turbulent stream.
Discussion: LORENZ G. STRAUB, pp. 264-265, comments on methods of collecting samples of suspended sediment-laden streams. A. G. ANDERSON, p. 265, makes pertinent remarks concerning Mr. Kalinske's article on the application of statistical methods to the measurement of velocity and suspended load in streams. THE AUTHOR, (Amer. Geophys. Union, Trans., vol. 27, no. 2, pp. 287-288, Apr. 1946), makes comments concerning comments made by L. G. Straub and A. G. Anderson in regard to use of statistical theory in measurements of velocity and suspended sediment in rivers.
 13. Movement of sediment as bed-load in rivers. Amer. Geophys. Union, Trans., vol. 28, no. 4, pp. 615-620, Aug. 1947.
Analyzes the movement of bed load, using the basic physical principles of fluid dynamics. Develops an equation for rate of sediment transport which fits various laboratory and field data.
- KALITIN, N.
1. Novy metod izmerenia kolichestva vzveshennykh v vode tverdykh chastits (New method of measuring the suspended-matter content of water). Sci. Inst. Amelior. Jour., no. 7, pp. 25-35, 1924. In Russian. Translation on file at the U. S. Soil Conservation Service, Washington, D. C.
Describes a method of measuring the quantity of solid particles suspended in water based on the application of the photo-electric effect phenomenon. Comments on the phenomenon of the photo-electric effect. The sediment speed of particles of various forms and dimensions can be determined by the photo-electric method.
- KAMMERMEYER, KARL.
1. (and Ward, Henry T.). Sedimentation in the laboratory. Indus. Engin. Chem., vol. 32, no. 5, pp. 622-626, illus., May 1940.
Deals with the experimental equipment and technique which permits the determination of settling data as well as particle size of the solid and viscosities of suspensions. A simple correlation is developed between the ratio of ultimate to initial settling height of suspensions. Viscosity data for suspensions of varying concentration are given. Analyzes the relative degree of accuracy of methods for reconstruction of settling curves. Modifications of these methods are suggested.
- KAMPMEIER, ROLAND A.
1. A critical analysis of Grove Karl Gilbert's "The Transportation of Debris by Running Water." 133 pp., June 1933. Unpublished thesis (M. S.) - State University of Iowa; [abstract], Iowa Univ. Studies in Engin. Bul. 19, pp. 56-57, May 1939.
Attempts to condense the information on bed-load movement of silt which is contained in The Transportation of Debris by Running Water (Gilbert, G. K., 11). Examines the theories and suggests improvements of the methods used by Dr. Gilbert. Gives various conclusions.
- KANTHACK, FRANCIS EDGAR. See also Buckley, A. B., 1.
1. The destruction of mountain vegetation. Dept. Agr., Cape of Good Hope, Agr. Jour., vol. 33, no. 2, pp. 194-204, Aug. 1908.
Discusses the effects of deforestation upon conditions of erosion, stream flow, and the transportation and deposition of erosional debris in the Union of South Africa. Stresses need for afforestation of mountain areas.
 2. The principles of irrigation engineering, with special reference to South Africa. 299 pp., illus. London, Longmans Green & Co., 1924.
Notes conditions in South Africa, of watershed erosion, stream erosion, transportation and deposition, the fertility of silt in irrigation waters, and the effect of silt on irrigation works. Summarizes results of research by various investigators on the nature of silt and its behavior in streams, canals, lakes, and reservoirs. The principles to be applied in sedimentation studies in South Africa are discussed. Data are given on the sediment content of streams, on the silting and desilting of reservoirs and canals, on the exclusion of silt from canals, and on the prevention of canal silting.
- KAO, C. Y.
1. (and Chang, J.). The Hai Ho palliative scheme. Assoc. Chinese and Amer. Engin. Jour., vol. 14, no. 2, pp. 14-23, illus., Mar. 1933.
Describes the design and construction of engineering works for the purpose of remedying the navigability of the Hai Ho in North China. Works include strengthening of Pei Yun Ho dykes to permit clear water supply to the Hai Ho and Pei Yun Ho, the construction of a sluice on the Pei Yun Ho whose operation will not be affected by silting above, the creation of an

- area in the French Marsh as a settling basin for silt carried down by the new channel in order to reclaim and make lands highly cultivable, and the construction of an escape channel to return clear flow from settling basin in order to scour bed and increase capacity of the Hai Ho. Three diversions of the Yung Ting Ho prevented the deposition of 13,254,000 cu. meters of silt into the Hai Ho, August to September 1932.
2. The Hai Ho palliative scheme in operation. Assoc. Chinese and Amer. Engin. Jour., vol. 14, no. 4, pp. 4-17, illus., July/Aug. 1933.
Describes results of operation of the Hai Ho palliative scheme works during summer freshet of 1932 and spring freshet of 1933. Reports the condition and extent of silt transportation by stream, regulating action of the palliative scheme, and silt deposition in the settling basin.
 3. The operation of the Hai Ho palliative scheme in the summer of 1933. Assoc. Chinese and Amer. Engin. Jour., vol. 14, no. 6, pp. 12-17, illus., Nov./Dec. 1933.
Describes difficulties encountered in the operation of the Hai Ho palliative scheme during the summer freshet of the Yung Ting Ho in 1933. Describes proposed project for the completion of the scheme. Reports the silt deposition in the Hai Ho during early summer freshet of 1933, also the conditions for diversion of the combined flow of Yung Ting Ho and Pei Yun Ho into the settling basin, and gives the modified location of the settling basin.
 4. The Kuan Ting detention basin project. Assoc. Chinese and Amer. Engin. Jour., vol. 15, pp. 14-20, July/Aug. 1934.
Describes the engineering details of the proposed Kuan Ting detention works which are expected to ameliorate the flood problem of the Yung Ting Ho. Gives data used in estimating the effective life of the silt detention basin.
 5. Diversion of 1935 summer freshet of the Yung Ting Ho. Assoc. Chinese and Amer. Engin. Jour., vol. 16, no. 6, pp. 297-305, illus., Nov./Dec. 1935.
Presents results on the diversion of the Yung Ting Ho during the summer flood of 1935. Data on inflow, outflow, and silt deposition of the settling basin are given. Describes regulatory improvements necessitated by the summer flood of 1934, comments on the success of improvements during summer flood of 1935, and notes proposed works to insure against the damage of future floods.
 6. Accomplishment of Hai Ho diversion works in 1936. Assoc. Chinese and Amer. Engin. Jour., vol. 18, no. 1, pp. 18-25, illus., Jan./Feb. 1937.
Describes the operation of the Hai Ho diversion works during the spring and summer freshets of 1936, and notes the conditions of sediment transportation and deposition.
- KAPUR, B. K.
1. Training works, river control and methods of regulation at Rupar, Rhanki, Merala and Rasul. Punjab Engin. Cong., Minutes of Proc., vol. 27, pp. 129-171, illus., 1939.
Describes the existing training works and methods of river control at the Rupar, Khanki, Rasul, and Merala shuttered-weirs in the Punjab and measures taken at each of these weirs at various times to exclude silt from the canal. Recommends the adoption of methods to secure the safety of the works during future floods.
- KAROLYI, ZOLTAN.
1. Kiserletek a hordalekfogoval (Experiments with bed load traps). Kulonnyomat a Vizugyi Kozlemenyek 1947.-evi 1-4. szamabol 15 pp. Budapest, 1947. Egyetemi Nyomda. (English summary, p. 14).
Describes experiments with bed-load traps in the upper part of the Hungarian Danube. Describes a recommended device which is suitable for measuring the bed load.
- KASTNER, KARL. See Woodford, A. O., 1.
- KEAYS, R. H. See Kramer, H., 2.
- KEEN, BERNARD A. See also Coutts, J. R. H., 1; Puri, A. N., 1.
1. First commission—soil mechanics and physics. Soil Sci., vol. 25, no. 1, pp. 9-20, Jan. 1928.
- Reviews developments in the field of mechanical analysis and considers the work of Odén, Fisher, Wegner, Krauss, Puri, etc.
2. Some comments on the hydrometer method of studying soils. Soil Sci., vol. 26, no. 4, pp. 261-263, Oct. 1928.
Makes various comments on the hydrometer method by Bouyoucos for the mechanical analysis of soils.
- KEGELES, GERSON.
1. A new optical method for observing sedimentation equilibrium. Amer. Chem. Soc. Jour., vol. 69, no. 6, pp. 1302-1305, illus., June 1947.
Outlines the theory and experimental method used to observe in a single photograph the concentration distribution and concentration gradient distribution at equilibrium. Uses a double prismatic cell containing the solution in one chamber and the reference solvent in the other. Notes results on the experiments using ovalbumin, and states that the method shows promise for accurate determinations of weight-average of molecular weights in polydisperse systems.
- KEILL, P. F.
1. Two centuries of accruing tragedy along the Dan River. Soil Conserv., vol. 1, no. 7, pp. 1-5, illus., Feb. 1936.
Describes conditions of erosion and denudation on the Dan River watershed, Virginia-North Carolina. Schoolfield Dam, above Danville, Va., furnishes evidence of rapid erosion. An island, embracing four-fifths of the reservoir and averaging 3 ft. in height above the usual water level was formed in 32 yr. During a 16-yr. period, 432 acres of the reservoir had been filled with soil to an average depth of 19 ft. Additional eroded soil was deposited on the lowlands, and thousands of tons were carried downstream. Discusses economic losses due to accelerated erosion on watershed. Points out that hope for future soil stability rests in proper soil and water conservation practices.
- KEIMIG, J. A.
1. Silt surveys—Guernsey Reservoir, North Platte Project, Nebraska, Wyoming. Reclam. Era, vol. 25, no. 9, p. 179, illus., Sept. 1935.
An article on silt surveys conducted by the Bureau of Reclamation at Guernsey Reservoir, North Platte Project near Guernsey, Wyo. The dam was completed in 1927 and after a year of operation, showed that considerable silting had taken place. For the regular silt surveys, 25 stations a half mile apart were set up with permanent markers. The daily reservoir elevation was used as the level datum for the silt survey. Survey was made when reservoir surface was frozen, cross sections were chained on the ice using the permanent markers as starting points and soundings were made through holes chopped in the ice. Silt deposit varied from 9 to 30 ft. in depth. The reservoir had lost 15 percent of its original capacity of 67,570 acre-feet between elevations 4,370 and 4,420 in 8 yr. Includes tables showing maximum and total inflow in second-feet and acre-feet respectively for each year between 1928 and 1935, and also the storage loss in acre-feet for every two years during the same period.
- KELLER, N. D.
1. (and Foley, Richard). Missouri River sediments in river water, ocean water, and sodium oxalate solution. Jour. Sedimentary Petrology, vol. 19, no. 2, pp. 77-81, illus., Aug. 1949.
Considers the mechanical analysis of mud suspended in Missouri River flood water by the measurement of its sedimentation in sodium oxalate solution, ocean water, and river water. Notes that analytical data may be of value in the interpretation of the history of rocks.
- KELLEY, W. P.
1. Base exchange in relation to sediments. In Trask, P. D., ed. Recent marine sediments, a symposium, pp. 454-465, illus. London, T. Murby and Co., 1939.
Treats of the problem of base exchange in sediments and points out that sediments high in clay are especially susceptible to base exchange and their properties may be substantially modified.

KELLOGG, C. W., JR.

1. The Rio Grande Reclamation Project. Stone and Webster Pub. Serv. Jour., vol. 3, pp. 176-178, illus., Sept. 1908.
Describes engineering details of the Engle Dam, Rio Grande Reclamation Project, N. Mex. Notes that observations indicate that the reservoir will be 60 percent full of mud in 82 yr. unless means are devised to sluice accumulations from the reservoir.

KELLOGG, JAMES L.

1. Conditions governing existence and growth of the soft clam (*Mya arenaria*). U. S. Conn. Fish and Fisheries, Rpt., 1903, pp. 195-224, illus., 1905.
Discusses the various factors controlling the growth and existence of the soft clam. Includes brief discussion on the effects of shifting bed material and the deposition of sediment upon the development of the clam.

KELLOGG, L. F. See Munns, E. N., 3.

KELLY, W. J.

1. Determination of distribution of particle size. Indus. and Engin. Chem., vol. 16, no. 9, pp. 928-930, illus., Sept. 1924.

Describes a method which is a modification of von Hahn's by which the size of particles and distribution of particle size can be easily and accurately determined; the validity of Stokes' law for the rate of settling is presupposed. This method was developed for the study of pigments and fine powders.

KELLY, WILLIAM.

1. The Colorado River problem. Amer. Soc. Civ. Engin., Trans., vol. 88, pp. 306-347, illus., 1925.
Discusses, in connection with the flood problem in the lower Colorado River, conditions of stream meandering, the effect of silt brought down by the river on the flood problem, and regulation of stream discharge by storage and other protective works to decrease the effect of sloughing banks and to avoid silting. Presents curves showing discharge, gauge heights, mean velocity and percentage of silt by weight for the Colorado River at Yuma, Ariz., for 1916.
Discussion: J. C. ALLISON, pp. 348-373, points out, in connection with the proposed All-American Canal, problems of maintenance involved due to probable conditions of canal scour and the transportation and deposition of wind- and water-borne sand. Factors in determining the capacity of the canal to transport injected sands are considered. Data on rate of movement of sand waves in the All-American Canal are given. FREDERICK H. FOWLER, pp. 373-379, comments on the Boulder Canyon project and the Federal Water Power Act. E. C. LA RUE, pp. 379-382, gives conclusions reached and makes various recommendations concerning the problem. ARTHUR P. DAVIS, pp. 382-393, points out, in connection with Kelly's proposed use of storage reservoirs to control the flow of the Colorado River, the problem of reservoir silting and proposed reservoir sites. Notes that silt carried by the Colorado River amounts to an average of about 100,000 acre-feet annually. C. E. GRUNSKY, pp. 393-396, considers the fact that the Colorado is an international river; notes that the United States should arrange all matters pertaining to flood control. F. E. WEYMOUTH, pp. 396-404, includes one paragraph noting that silt inflow at Boulder Canyon is estimated at 80,000 acre-feet annually; this amount will decrease with upstream reservoir construction. G. E. P. SMITH, pp. 404-410, comments on water supply and division of the water supply. Considers the Diamond Creek Project. LOUIS C. HILL, pp. 411-417, deals with power development, irrigation, and flood control. C. S. JARVIS, pp. 417-418, treats storage reservoirs and water supply. E. W. LANE, pp. 418-419, notes the probable conditions of degradation below the proposed Boulder Dam, the factors influencing the quantity of silt removed, and the effect of lowering the river bed. RAYMOND A. HILL, pp. 419-422, points out Kelly's use of curves showing relations between percentage of silt and discharge of the Colorado at Yuma, between velocity and discharge, and

area-discharge relation. Presents curve showing volume of silt carried by the Colorado at various stages. E. B. DEBLER, pp. 422-425, shows the effects of reducing flood discharge of the Colorado, by storage works, on bank protection and maintenance. Notes possible alternations in the regimen of the Colorado below Boulder Canyon when silt is cut off by dam construction. THE AUTHOR, pp. 425-437, comments on Davis' argument that Boulder Canyon must be reserved for silt; notes that small Boulder Canyon Dam will retain 100,000 acre-feet annually and total deposit of stream for 100 yr.; complete desilting at Boulder will increase the tendency of the river to pick up vast quantities of bed and bank material from that point at Yuma. Answers Lane's query relative to conditions of degradation below Boulder Dam. The effect of silt storage at Laguna Dam on the conditions of degradation below the dam was obscured by the Bee River and Volcano Lake diversion of 1909. Author reviews other discussions.

KEMBLE, FRANCES ANNE.

1. Journal of a residence on a Georgian plantation in 1838-1839. 337 pp. New York, Harper & Bros., 1863.

Excerpts from a diary which includes observations on formation of mud banks at the mouth of the Altamaha River.

KEMP, HAROLD A.

1. Soils pollution in the Potomac River basin. 21 pp., illus. Washington, Interstate Comm. on the Potomac River Basin, 1949; [abstract], Amer. Water Works Assoc. Jour., vol. 41, no. 1, pp. 792-796, Sept. 1949.

Consists of an address, delivered at the spring meeting of the Interstate Commission on the Potomac River Basin and joint conference with agricultural, soil conservation and forestry officials in the Potomac River basin, Apr. 21, 1949, which treats of the problem of pollution by soil erosion. Notes that last year the mud load of the Potomac at Washington was 1,650,000 tons, and points out the effect of excess turbidity on fish life. Mentions the high cost of dredging. Considers the value of sewage sludge as a fertilizer.

KEMP, JAMES F.

1. The geology of Manhattan Island. N. Y. Acad. Sci., Trans., vol. 7, pp. 49-64, illus., Nov. 14, 1887.
Includes one paragraph describing the characteristics and conditions of deposit of alluvium in the Hudson and Harlem Rivers.

KENERSON, WALDO I. See Campbell, F. B., 1.

KENNEDY, J. C. See Lane, E. W., 13.

KENNEDY, ROBERT GREIG.

1. The prevention of silting in irrigation canals. Inst. Civ. Engin., Minutes of Proc., vol. 119, pp. 281-290, illus., 1895; also in Punjab Pub. Works Dept., Irrig. Branch Papers 7, pp. 8-14, 1896.
Presents results of observations relative to the hydraulic conditions of the Bari Doab Canal, India, in order to determine the relationship between the factors, bed width, channel depth, and mean velocity which will ensure non-silting bed conditions.
2. Instructions for grading and designing irrigation channels—dated 25th August, 1904. Punjab Pub. Works Dept., Irrig. Branch Papers 10, pp. 51-53, 1905.
Instructions for the grading and designing of irrigation channels to ensure an early attainment of regime of flow.
3. (and others). Report on the deposit, and scour of silt in the Main Line, Sirhind Canal, and on the silt experiments 1893 to 1898. Punjab Pub. Works Dept., Irrig. Branch Papers 9, 82 pp., illus., May 17, 1905.
Discusses generally the deposit and scour of silt in the Main Line, Sirhind Canal, India. Comments on silt experiments which were worked on from 1893 to 1898. Considers training spurs, silt detection, silt measurement, scour, analysis of silt, silt movers, and sand separators.
4. Hydraulic diagrams for channels in earth, giving discharges, mean velocities, and silting data for varying bed widths, depths and slopes. Punjab

Pub. Works Dept., Irrig. Branch Papers 7, 4 pp., illus., 1907.

Discusses diagram to give by mere inspection the mean velocities and discharges of ordinary earthen channels. The basis of all calculations is Ganguillet and Kutter's formula. Discusses silt in channels and its disposal. Treats of the determination of critical non-silting mean velocities.

5. Hydraulic diagrams for channels in earth, giving discharges, mean velocities, and silting data for varying bed widths, depths, and slopes, based on Ganguillet & Kutter's formula. Ed. 2, 5 pp., tables and graphs. New York, Spon and Chamberlain, 1931; [abstract], Civ. Engin., vol. 2, no. 4, p. 282, Apr. 1932.

Includes diagrams showing mean velocities and discharges of earthen channels and tables giving data on design of channels to avoid sedimentation.

KENT, R. J.

1. Silt observations. Punjab Pub. Works Dept., Irrig. Branch Papers 28, pp. 104-122, Feb. 8, 1926. Presents results of silt observations on the Indus River at Sukkar and Kotri, 1911-20, at Dera Ghazi Khan, 1911-14, and at Mithankot above and below junction with Chenab, 1915-20.

KENYON, E. C., JR. See also Sopp, C. W., 1.

1. The functions of debris-dams and the loss of reservoir-capacity through silting. Amer. Geophys. Union, Trans., vol. 20, pt. 1, pp. 16-21, July 1939. Describes the operation of debris dams and the reduction in capacities to flood control reservoirs by the accumulation of debris in Los Angeles County, southern Calif. Discusses physiographic history of southern California region, conditions of rock disintegration, debris movement by landslides, transportation out of canyons by running water, and fanglomerate accumulations below canyon mouths. Describes conditions of increased debris movement from denuded areas in the Montrose-La Cresenta area following New Year's 1934 flood; estimated total deposits amounted to 659,000 cu. yd. Function of debris dams and basins to provide storage capacity for debris during flood flows is discussed. Observations on debris load of runoff from denuded area in Pickens Canyon during flood of Oct. 18, 1936 are given, based on surveys of basin capacities before and after the storm. Use of debris basins as spreading grounds is discussed noting effect of a large amount of fines in suspension in debris basins on the sealing up of pores in sands and gravels. The effectiveness of basins in Montrose-La Cresenta and Glendale areas during the storm of March 1938 and effect of basin design are described. Gives losses in capacity of 15 reservoirs in district due to silting primarily during flood of March 1938. Total loss in capacity amounted to 10,855 cu. ft. Thompson Creek Reservoir lost 3 percent of its capacity, Sierra Madre Reservoir lost 83 percent, and reservoir behind San Gabriel Dam No. 1, lost 10 percent. Of the 15 reservoirs four lost over 50 percent of their original capacities, five lost between 25 and 50 percent, and the remaining five lost over 9 percent. Observations on the movement of upstream deposits into reservoirs are given. Notes average rate of erosion from watersheds above reservoirs.

KENWORTHY, O. C. See Collins, W. D., 6.

KERMACK, W. O.

1. (and Williamson, W. T. H.). The stability of suspensions—I. The rate of sedimentation of kaolin suspensions by salts at varying hydrogen ion concentrations. Roy. Soc. Edinb., Proc., vol. 45, pp. 59-70, illus., 1924-25.

Describes and presents results of experiments comparing the rates of sedimentation of kaolin suspension in the presence of varying concentrations of a salt at various pH values.

KERNS, F. W. See Parshall, R. L., 2.

KERR, C. H.

1. Forty years of reservoirs. Mont. Farmer, vol. 29, no. 11, p. 7, Feb. 1, 1942. Kerr Bros. built 16 reservoirs over a period of 40 yr., of which 12 are located in northern part of Valley County. Of these 12, three were filled

with mud, two useless because of leakage, one spillway washed out, and six are still in operation. Most of them were built between 1918 and 1936. Discusses lessons learned and gives items to keep in mind when constructing reservoirs in this region.

KERR, F. M.

1. The levees of the Red River in Louisiana [abstract]. Engin. News, vol. 39, no. 19, pp. 309-310, May 12, 1898.

A paper read before the Louisiana Engineering Society, summarizing the effects of floods in the Red River basin, La. Describes river basin noting that the Red River in Louisiana has easily erodible banks and carries red silt in its waters. Shifting of channel is caused by vast amounts of drift transported and consequently, causes jams and dams. Large part of the alluvial soil of valley rests upon vast beds of timber brought down in the remote past. Describes methods adopted to protect levees on the Red River and to increase discharge.

KERR, PAUL F. See Ross, C. S., 1.

KESLER, THOMAS L.

1. Advance report on the sedimentation survey of Lake Spavinaw, Spavinaw, Oklahoma. U. S. Soil Conserv. Serv., SCS-SS-1, 5 pp., illus., Mar. 15, 1936.

A sedimentation survey of Lake Spavinaw, a municipal water supply reservoir located on Spavinaw Creek at Spavinaw, Okla., during June and July 1935. The original storage capacity of the reservoir amounted to 31,686 acre-feet when constructed in April 1924. At the end of a 11-yr. period, at the time when the survey was made, 1,177 acre-feet of sediment had accumulated in the reservoir. This was an average rate per year of 0.338 percent of the original storage capacity. Total depletion of storage amounted to 3.72 percent of the original capacity. The drainage area comprises 400 sq. miles of which 80 percent is scrub timber. Severe sheet erosion and gulleys occur over 35 percent of the watershed area. Detailed information is included on character, volume and distribution of sediment in the reservoir. Gives engineering features of the dam and reservoir.

2. Advance report on the sedimentation survey of Lake Taneycomo, Taney County, Missouri. U. S. Soil Conserv. Serv., SCS-SS-8, 8 pp., illus., Sept. 1936.

A sedimentation survey conducted during the period July 23 to Nov. 2, 1935, of a channel reservoir, used for electric power, and located on the White River, 50 miles south of Springfield, Mo., revealed that the reservoir had lost due to silting, 46.08 percent of its original capacity since its completion in March 1913. The average annual loss amounted to 2.06 percent. Total deposits in the 43,980-acre-foot reservoir amounted to 20,266 acre-feet during the 22.4 yr. of operation, an average accumulation per year amounting to 904.7 acre-feet. Of the total watershed area of 4,610 sq. miles, 65 percent is forest, 25 percent pasture and abandoned farm land, and 10 percent is cultivated land. Detailed data are presented on the engineering features of the dam and reservoir, the character of the watershed, the causes of reservoir silting, and the character, distribution, and origin of sediment in the reservoir.

KESSELI, JOHN E.

1. The concept of the graded river. Jour. Geol., vol. 49, no. 6, pp. 561-588, illus., Aug./Sept. 1941.

A critical analysis of the concept of the graded river which assumes the attainment of a balance between power and load. A review of the graded river concept is given; notes origin of notion of balance or equilibrium in rivers, and reviews and evaluates the geomorphological ideas of Surell, Dausse, Gilbert, and Davis. Common variations in volume of flow and the influence of turbulence in debris transportation suggests that the attainment of a full load in a stream and the maintenance of a stable load is quite impossible. Advantages resulting from the abandonment of the concept of grade in streams are considered.

KETCHUM, C. C.

1. Silt canal lining saves irrigation water. Reclam. Era, vol. 31, no. 4, pp. 114-115, 126-127, illus., Apr. 1941.

Describes means employed in the utilization of silt to line canals of the Vale project, Malheur River, Oreg. The hydraulic method is used to obtain silt for canal lining.

KEULEGAN, GARBIS H. See also Dobbins, W. E., 1.

1. Laws of turbulent flow in open channels. U. S. Natl. Bur. Standards Res. Jour., vol. 21, pp. 701-741, illus., Dec. 1938.

Discusses application of the principles deduced from the theoretical investigations of Prandtl, Karman, and Nikuradse, dealing with velocity distribution and hydraulic resistance for turbulent flow in circular pipes, to the problem of turbulent flow in open channels. Application of rational formulas for turbulent flow in open channels to Bazin's experimental data is made.

KEUTNER, C. See Anonymous, 143.

KHANGAR, S. D.

1. Regime slope in irrigation channels. Indian Engin., vol. 96, pp. 468-471, July/Dec. 1934.

An analysis made of observations on the hydraulic characteristics of irrigation channels in stable regime. Develops a new formula for regime slope.

KHANNA, RADHA KRISHNA. See also Lacey, G., 9.

1. Hydraulics and design of open earthen channels with a note on the distribution of water. 200 pp., illus. Lahore, Mercantile Press, 1933.

Presents an explanation for the silting and scouring phenomena in open channels based on accepted theory and evolves a rational basis for the correct design of hydraulic sections.

2. Silt theory of flow of water. 50 pp. Lahore, Mercantile Press, 1935; also in Indian Engin., vol. 99, no. 2, pp. 68-71; no. 3, pp. 91-98, Feb.-Mar. 1936. Presents a silt theory of flow in open channels with a view toward the design of artificial channels wherein conditions of silting and scouring are controlled. Discusses the general tendency of flowing water to maintain the quality of lining material required for conditions of flow and, in this connection, considers the energetics of stream flow, the effect of the presence and grade of silt upon the regime of channels, the effect of volumes of water and slopes of flow upon qualities and grade of lining materials, retrogression of levels, channel degradation in mountain and submountain regions, and bed silt movements. Derives a tentative mathematical formula for mean velocities of flow in terms of hydraulic radii and slopes of channels, requiring no further consideration of roughness factors in alluvial channels. Considers the silt problems of artificial channels, conditions of bed scour, factors involved in the success of silt excluding devices, use and results of silt excluding devices, principles of design and maintenance of artificial canals and connective works, and the effectiveness of the "still pond" system of reducing the quantities of silt entering into canals.

3. Consideration of silt in the design and maintenance of open earthen channels. Indian Engin., vol. 102, no. 5, pp. 169-170, Nov. 1937.

Discusses the general problem of design and maintenance to prevent scour and sedimentation of canals. States that many theories were advanced to account for silting phenomena and that eventually Kennedy formulated his famous theory which is the last resort of present irrigation engineers. Discusses the effects of mean depths on velocities of flow and relation to sediment transportation in canals. Gives effective limitations of control measures particularly excluding devices. Discusses canal conditions in aquatic adjustment to sediment load.

4. Consideration of slopes of flow in the design and maintenance of artificial channels. Indian Engin., vol. 102, no. 6, pp. 213-214, Dec. 1937.

Discusses the automatic adjustment of channels to silt grades and its relationship to design and maintenance of canals. States that the slope of channels must necessarily be adjusted to existing conditions of soils and slopes and that once the question of slopes of flow has been designed in the pursuit of essential requirements, it is a matter of little consequence which formulas or

tables are used for fixing bed widths and depths. States that Chezy's velocity formula with Kutter's coefficients is perhaps the most accurate. Presents the author's formula and states that it is a handy formula because it dispenses with the necessity of making indefinite assumptions of coefficients.

5. Stable channels in erodible material. Indian Engin., vol. 103, no. 5, pp. 168-170, illus., May 1938.

An article on irrigation canal design summarizing conclusions of Prof. E. W. Lane of the Iowa Hydraulic Research Institute as included in a paper before A. S. C. E. in 1935 on an investigation of canal sections for the All-American Canal. Based on the author's previously published papers in "Indian Engineering," on experiments on the Sirhind Canal, India, and on historical evidence, such as the Annasagar Lake in Ajmer, India, it is concluded that Boulder Dam will not be very effective in desilting Colorado River water and also that the All-American Canal, owing to sedimentation and bank erosion will tend to become wider and shallower than its original design. According to a formula presented, the slope of the All-American Canal is stated to appear excessive. Discusses theory of silt and scour in relation to the All-American Canal and to various canals in India.

6. Fundamentals of river and canal hydraulics. Indian Engin., vol. 106, no. 1, pp. 32-35, July 1939.

A critical study of the general characteristics and marked peculiarities of the flow of water in earthen channels. Discusses formulae for computing flow in earthen channels. Describes the formation of alluvial plains caused by silt deposited through the ages; considers variations in slope, conditions of transportation and deposition of material tending towards river stability, and the natural preservation of its regime. Reports observations made of boulder behavior in the Jhellum Canal, noting that energy or regime requirements of flow determine the size and distribution of boulders as lining material in streams. Comments on the effect of variations in slope on the sizes of lining materials of rivers, the tendency of rivers to keep waterways clear for normal maximum flow through them, and the gradual contraction of sectional areas of rivers by silting when normal maximum supply decreases. Considers the use of embankments as a protective measure against floods. Gives observations on the effects of embankments on channel regimes.

7. When ignorance is not bliss. Indian Engin., vol. 106, no. 5, pp. 156-157, Nov. 1939.

Stresses the necessity for knowledge relative to the relation of energy of flow of water to the grades of silt present in bed and sides of any channel. States that knowledge of this relationship would eliminate efforts of dealing with silt troubles by excluding silt from canals. Criticizes the Lacey theory.

8. Problems of irrigation engineering. Indian Engin., vol. 107, no. 4, pp. 101-102, Apr. 1940.

Comments by the author on problems of irrigation engineering, including silt theory, empirical formulae, channel dimensions, silt transportation, water flow, slopes, artificial channels, working head, and hydraulic research.

KHOSLA, A. N.

1. Reconstruction of the Khanki weir. Punjab Engin. Cong., Minutes of Proc., vol. 24, pp. 107-135, illus., 1936.

Gives engineering details of the reconstruction of the Khanki weir, lower Chenab Canal, India. Measures for silt exclusion which formed part of the plan for reconstruction are given.

2. Silting of reservoirs. 78 pp., illus. Lahore, India, High Dams Circle, Punjab Irrigation Secretariat, 1940.

Presents results of silting investigations at various dams and reservoirs, and gives data resulting from silt investigations on the River Sutlej, in connection with the proposed Bhakra Dam. Discusses the origin of silt, catchment area characteristics affecting the silting of reservoirs, the magnitude of suspended and bed loads of streams, relationship of silt distribu-

tion and velocities in stream cross-section silt content at varying stream stages, and volume-weight relationship of deposited silt. Cites instances of heavy silt concentrations in various streams. Gives data on location, drainage area, height of dam, capacity, and amount and rate of silting for 79 reservoirs in different parts of the world. Discusses, in detail, results of silt studies at the Aswan, Boulder, Grand Coulee, Lake Austin, Elephant Butte, Lake McMillan, Roosevelt, Lake Worth, Suni, Parksville, Medina, Gibraltar, and Sweetwater Reservoirs, also at four large reservoirs in South Africa. Notes silt studies of proposed Bhakra, Balehu, and other storage sites located in the Punjab. Discusses silt load of River Sutlej at Bhakra, and gives comparative estimated data for silt loads of Bhakra and Boulder Reservoirs. Compares the silt loads of the Sutlej and Beas Rivers.

KHUSHALANI, K. B.

1. Rolling theory of water. 57 pp., illus. Karachi, India, 1938; [abstract], *Indian Engin.*, vol. 102, no. 3, pp. 102-108, illus., Sept. 1937. Presents a new theory of flow in regime channels, which theory, besides utilizing the best in the theories of Kennedy and Lacey, is also in accordance with experimental results.

KIDDER, A. W.

1. Imperial Dam and desilting works. U. S. Bur. Reclam., Dams and Control Works, pp. 137-143, illus., Feb. 1938. Describes the various engineering features of the Imperial Dam and the desilting works under construction across the Colorado River, above Yuma, Ariz.

KIDWELL, A. L.

1. [Review of] Fine-grained alluvial deposits and their effects on Mississippi River activity, by Harold N. Fisk. *Jour. Geol.*, vol. 56, no. 6, p. 591, Nov. 1948. States that the Mississippi River and its alluvial valley are generally discussed by this report (Fisk, H. N., 3) in regard to its recent geologic history and physical geology. Notes that fine-grained alluvial deposits are considered from the point of view of description, depositional environment, and physiographic expression. The distribution and thickness of deposits were determined by surface mapping and boring. The properties of the fine-grained sediments were dealt with for each type of environment in regard to grain size, degree of sorting, size distribution and water content. Describes the effect of fine-grained sediment on Mississippi River activity in regard to channel migration, bank caving, stream meandering, development of reaches and channel cross section.

KIEFFER, STEPHEN E. See Harts, W. W., 2.

KIERSTED, W.

1. Reinforcement of the walls of the Kansas City settling basins and the use of a coagulant to aid clarification. *Engin. News*, vol. 43, no. 1, pp. 3-5, illus., Jan. 4, 1900. Describes the buttressing of the Kansas City settling basin walls and the use of a coagulant as a supplement to sedimentation. Gives sediment content and alkalinity of Missouri River water during several months in 1899 and notes that estimated sediment content during May, June, and August of the same year amounted to 11 1/2 cu. yd. per 1,000,000 gal. of water.
2. Sedimentation of turbid river water. *Engin. and Contract.*, vol. 63, no. 6, pp. 1268-1274, June 10, 1925.

A paper read before the Southwest Water Works Association describing various types of settling and coagulating plants. Includes five paragraphs discussing the action of sedimentation in settling basins and notes the factors affecting the rate of settling.

KINDLE, EDWARD M.

1. Small pit and mound structures developed during sedimentation. *Geol. Mag.*, Decade 6, vol. 3, pp. 542-547, illus., 1905. Describes the processes of sedimentation observed under laboratory conditions which cause the formation of small pits or mounds at

the top of chimney-like tubes in the falling sediment. The experiments illustrate a series of phenomena which are allied if not identical with catalysis. Gives the work of various authors which show the effect of salt and other constituents of sea water in the acceleration of sedimentation. Experiments were made in the presence of salt with fine-grained blue Pleistocene clay of Ottawa Valley directing attention to the action of vertical currents developed during the deposition of clay sediment.

2. Some factors affecting the development of mud-cracks. *Jour. Geol.*, vol. 25, no. 2, pp. 135-144, Feb./Mar. 1917.

Presents results of laboratory experiments conducted to determine the nature and extent of mud cracks under varying conditions of formation. It was found that rapid desiccation produced mud cracks which are more widely spaced than those produced by slow desiccation. The composition and resulting tenacity of mud affects the spacing of mud cracks. Approximate parallelism of mud cracks may result from zonal drying of mud. A high degree of salinity delays the formation of mud cracks and results in polygons in which the margins are inclined downward.

3. Recent and fossil ripple-mark. *Canada Natl. Mus. Bul.* 25, 119 pp., illus., Mar. 25, 1917.

Presents results of a study to secure more precise conceptions of the significance of different types of ripple marks. The study was confined to the description and illustration of phases of ripple-mark phenomena met with on sandy sediments and their correlation with geologic agencies which produce them. Includes discussion on asymmetrical or current ripple-mark, occurrence of ripple marks, formation and factors determining formation, movement and factors affecting movement, and amplitude of ripple-mark.

4. Diagnostic characteristics of marine clastics. *Geol. Soc. Amer. Bul.*, vol. 28, pp. 905-916, illus., Dec. 14, 1917.

Deals with the distinctive features characteristic of marine rocks. Includes description of experiments to determine relative rates of deposition of fine clay in saline and in fresh water.

5. Notes on sedimentation in the Mackenzie River basin. *Jour. Geol.*, vol. 26, pp. 341-360, illus., May/June 1918

Deals with the significant features of lacustrine sedimentation in the region of Great Slave Lake, Canada, and discusses other factors relating to sedimentation in the Mackenzie River basin. Materials constituting the valley floors of the Peace, Athabasca, Slave, and Mackenzie Rivers are described. Discusses the relative turbidity of the Mackenzie, Peace, Athabasca, and Laird Rivers noting that the Great Slave Lake acts as a settling basin for the sediment carried into it by the Slave River. Describes the phenomenon of parallel streams of clear and muddy water below the Laird flowing side by side in the Mackenzie River. Discusses conditions of stream erosion and deposition in the lower Athabasca and lower Slave Rivers, bank erosion, bar and alluvial island formation, and the vegetative growth on islands. Contrasting features of stream erosion and deposition along the Mackenzie River are described. Boulder pavements along both banks of the stream, and features of the ice work along the banks are noted. Reports conditions of sedimentation in Lake Athabasca and the Great Slave Lake.

6. Unusual type of sand bar. *Pan-Amer. Geol.*, vol. 39, no. 1, pp. 15-16, illus., Feb. 1923.

Describes and discusses the probable causes of an unusual type of sand bar found by writer on Red River, Laborador. Curious pit-and-ridge structure was co-extensive with the entire bar.

7. The bottom deposits of Lake Ontario. *Roy. Soc. Canada, Proc. and Trans.*, (ser. 3) vol. 19, sect. 4, pp. 47-102, illus., 1925.

Presents in detail data on the bottom sediments of Lake Ontario. Includes description of construction and operation of apparatus for sampling bottom material.

KINDLE, EDWARD M. - Continued

8. Contrasted types of mud-cracks. Roy. Soc. Canada, Proc. and Trans., (ser. 3) vol. 20, sect. 4, pp. 71-75, illus., 1926.

Contains photographs of good examples of mud cracks formed under different conditions, including mud cracks in mud derived from volcanic rocks, playa and reticulated playa mud cracks, radiate mud cracks, mud-crack ridges, and desiccation ridges.

9. The role of thermal stratification in lacustrine sedimentation. Roy. Soc. Canada, Proc. and Trans., (ser. 3) vol. 21, sect. 4, pp. 1-35, illus., 1927.

A study concerned with the significance of thermal stratification of water with reference to lacustrine sedimentation; this is important in understanding the different lake bottom facies. A study was made of small lakes of the Ottawa River Valley near Ottawa, Canada. Discusses water stratification, temperature curves, and experiments under laboratory conditions. Contrasted sediments are correlated with thermal stratification. Considers the deposition of marl.

10. The intertidal zone of the Wash, England. Natl. Res. Council, Reprint and Cir. Ser. 92, pp. 5-21, illus., 1929.

Deals with investigations relative to the biological relations of the fauna and the physical features of the sediments deposited in the intertidal zone of the Wash, England. Discusses rate of advance of shore line, source of sediments of the Wash, topography of the bottom, distribution of dominant forms of life on the intertidal zone, bathymetric range of mollusca, character of sands of the Wash, occurrences and character of black sand and fen silt, and the laminated structure of the recently formed sediments.

11. Experiments with the settling of bentonite in water. Natl. Res. Council Bul. 89, pp. 68-73, illus., Nov. 1932.

Describes the lamination of the sediments and zoning of the colloidal suspensions developed during the course of two sets of experiments started 9 and 12 yr. ago respectively, dealing with the settling behavior of bentonite. Notes experiment by writer in order to observe the early stages of settling.

12. (and Cole, L. H.). Some mud crack experiments. Geologie der Meere und Binnengew., vol. 2, no. 2, pp. 278-283, illus., July 15, 1938.

Presents the results of laboratory experiments to investigate mud cracks developing from different materials under same laboratory conditions. Presents summary of results.

KING, BYRON F.

1. The mineral composition of sands from the Monongahela, Allegheny, and Ohio Rivers [abstract]. W. Va. Acad. Sci. Proc., vol. 5, no. 2, p. 148, Aug. 1931.

The mineral composition and source of sands deposited in the Monongahela, Allegheny, and Ohio Rivers are discussed. Quartz forms the greatest amount of sediments found. Mineral samples taken from the Allegheny and Ohio Rivers indicate direct derivation from igneous and metamorphic rock. Sediments from the Monongahela and Cheat Rivers have small mineral content, due to weathered condition of rock from which they are derived.

KING, C.

1. Practical design formulae for stable irrigation channels. India Cent. Bd. Irrig. Pub. 31, pp. 52-60, illus., 1944.

Derives equations for stable channels in alluvium, treating as parallel case to smooth pipes, and designates likeness to data of Punjab and Sind.

KING, F. H.

1. Farmers of forty centuries or permanent agriculture in China, Korea and Japan. 431 pp., illus. Madison, Wis., Mrs. F. H. King, 1911.

A travel book describing journeys through Japan, China, and Korea. Includes observations on extent of canalization and surface fitting of soils, customs of the people, utilization of waste, rice culture, and tea industry. Contains

much information on utilization of canal mud for providing better drainage of fields and for fertilizing land by applying it directly to the soil or by preparation of a compost with manure. Methods of dredging mud from bottom of canals and methods of application of dredged mud to land described in detail.

KING, H. W.

1. Silt exclusion from distributaries. Punjab Engin. Cong., Minutes of Proc., vol. 21, pp. 263-308, illus., 1934.

A paper with discussions dealing with the exclusion of adjustment of silt entry into a channel. Considers conditions of silt transportation in a stream of water, causes of silting at right angled offtakes, common cause of silting, the effect of channel contraction upon bed scour, the effect of good working head upon silting, and rapidity of berm growth when silt is excluded from a channel. Describes the various silt excluding devices and discusses the efficiency of silt vanes, also of silt vanes with curved-wing arrangements. Includes details required in the design of silt vanes and of silt vanes with curved-wing.

KING, L. C.

1. South African scenery. 340 pp., illus. Edinburgh, Oliver and Boyd, Ltd., 1942.

A textbook dealing mainly with South African geomorphology. Contains a chapter on the erosive action of streams which treats soil erosion, river transport, stream abrasion, degradation and aggradations, and deltas. Notes that the Orange River carries about 50,000,000 tons of sediment to the sea annually, and that the nine main rivers of the Union carried 187,000,000 tons of soil to the sea during 1919-20.

KING, W. NORMAN.

1. Do cattle kill fish? Hawaii Farm and Home, vol. 8, no. 2, pp. 10-11, Feb. 1945.

Treats the problem of over-grazing by cattle and cultivation which has caused fish ponds in Molokai, Hawaii, to become silted up, thus affecting chances of a major industry in fish.

KING, W. R. See also Engels, H., 1.

1. The improvement of southern and western rivers [abstract]. Sci. Amer., vol. 38, no. 16, p. 247, Apr. 20, 1878.

Describes details of work for the improvement of the Tennessee River above Chattanooga, and of the Cumberland, Coosa, and Hiwassee Rivers, by the removal of shoals and other obstructions.

KINNEY, ABBOT.

1. Forest destruction and waterflow, southern California. Forester, vol. 4, no. 4, pp. 82-83, Apr. 1898.

Describes observations relative to the effect of forest destruction on floods and flood damages in southern California. Notes effects of denudation by fire on the watershed of Precipice Canyon on the filling of the watercourse with sand and boulders.

2. Forest destruction and waterflow. Forester, vol. 4, no. 5, pp. 106-107, May 1898.

Reports writer's observations of the effects of denudation of the mountains on the west side of the Santa Ana River, San Bernardino Reservation, Calif., caused by the fire of 1895. Watercourses coming from the burned areas cut gullies and carried sediment into the Santa Ana River affected the fish life. The tributaries from the burned area diminished and in some cases dried up.

KINNEY, S. P. See Perrott, G. St. J., 1.

KIRKBRIDE, W. H.

1. Bonito rockfill dam, New Mexico. West. Construct. News, vol. 7, no. 17, pp. 501-504, illus., Sept. 1932.

Points out the need for Bonito rockfill dam and reservoir in New Mexico and gives consideration to the design, construction, geology, flow measurement, and settlement. Includes a paragraph on the provision for permanent bench marks needed for silt surveys. Results of surveys made in April 1931 and April 1932, indicate silt accumulation on north side during the year was 171 cu. yd. There was no appreciable silt on the westerly area of reservoir.

2. A railroad fights floods. *Civ. Engin.*, vol. 9, no. 12, pp. 711-714, illus., Dec. 1939.

Discusses the problems of damages to the Southern Pacific Lines by a flood caused by a downpour which struck the Pacific Coast at the end of February and beginning of March 1938. Notes the effect of debris movements and sediments caused by the downpour. Points out that culverts and bridges should be designed for flash rather than sustained runoff.

KIRKHAM, DON.

1. Modification of a theory on the relation of suspended to bed-material in rivers. *Amer. Geophys. Union, Trans.*, vol. 23, pt. 2, pp. 618-620, Nov. 1942.

A report which develops the theoretical equation for the relation between the quantity of suspended load in a stream and bed and channel characteristics.

Discussion: J. W. JOHNSON, p. 621, comments on the author's equation and the relationship of Lane and Kalinske for suspended-load calculation. Notes the need of determining functional relationships of bed-load formulas by the same type of laboratory experiment as used for the equation of Lane and Kalinske.

KIRKPATRICK, W.

1. The method adopted to exclude heavy silt from the Jamrao Canal. *Bombay Engin. Cong., Proc.*, (1923) vol. 12, pp. 1-8, illus., 1924.

Describes the headworks of the Jamrao Canal, India, and reports the method of control adopted at the headworks from 1910 to 1918. Notes results of method used since 1919. Discusses the application to headworks of the revised method of control.

KITTREDGE, FRANK A. See Parker, T. C., 1.

KLEIN, ALEXANDER. See Biddle, S. B., Jr., 1.

KLINGEBIEL, A. A. See Stall, J. B., 1.

KLORER, JOHN.

1. The flood problem of the lower Mississippi River. *Amer. Soc. Civ. Engin., Trans.*, vol. 82, pp. 1007-1014, illus., 1924.

Describes the proposed spillway into Lake Borgne to provide for flood protection and flood relief to the lower Mississippi. The feasibility of spillways in the lower Mississippi basin is discussed with consideration given to conditions of sedimentation and erosion subsequent to proposed improvement.

Discussion: C. W. CHAPIN, pp. 1129-1135, describes the Mississippi River flood of 1922, and discusses the use of spillways as a flood control measure. Notes that samples of water taken from the Mississippi River 35 miles above New Orleans in April and May 1922, showed an average turbidity of 830 p.p.m., and 710 p.p.m. respectively.

KNAPP, F. See Campbell, F. B., 1.

KNAPP, ROBERT T. See also Bailey, R. W., 4; Oaks, R. M., 1; Sharpe, C. F. S., 3; Simmons, H. B., 1.

1. New apparatus for determination of size distribution of particles in fine powders. *Indus. and Engin. Chem., Analyt. Ed.*, vol. 6, no. 1, pp. 66-71, Jan. 15, 1934.

Describes an apparatus for determining size distribution of particles of subieve material based on the sedimentation method. The apparatus, a micrometer, meets specifications which were set up as prerequisites for a successful instrument.

2. Energy-balance in stream-flow carrying suspended matter. *Amer. Geophys. Union, Trans.*, vol. 19, pt. 1, pp. 501-505, illus., Aug. 1938.

A study of energy-balance of flow to determine mechanism by which a flowing fluid transports solid material in suspension. States hypothesis that particle in suspension in flowing stream adds to or subtracts energy from stream, adding energy by increasing concentration of particles, and subtracting energy by maintaining a definite load carrying capacity. Formulas are included. Alternate formulation of hypothesis that concentration of sediment of a given size which can be transported by a stream is unlimited except by fluidity, if vertical component of stream velocity is greater than velocity of free fall of same sediment at same concentration in same fluid at rest. Discusses factors determining the normal load capacity of a flow,

the effect of other material in suspension on load-carrying capacity of stream for given particle size, the transportation of large fragments, and the effect of energy utilized in suspension on energy-balance of stream as a whole. Notes conclusions of W. W. Rubey and H. L. Cooke on a similar study.

3. Density currents. *Internatl. Geod. and Geophys. Union, Round-Table Discuss.* 8 pp. Washington, 1939.

Report for the round-table discussion on The Role of Hydraulic Laboratories in Geophysical Research, at the National Bureau of Standards, Sept. 13, 1939, relative to the study of density currents. Defines density currents and history of analytical and experimental investigations. The present status of knowledge and future needs is discussed.

4. Density currents; their mixing characteristics and their effect on the turbulence structure of the associated flow. *Iowa Univ. Studies in Engin. Bul.* 27, pp. 289-306, 1943.

Defines density currents and cites familiar examples. Gives flow characteristics. Considers how density currents can be stopped. Notes various ways in which mixing takes place between density currents and the surrounding fluid. Discusses their effect on turbulence structure. Investigates the behavior of density currents in regard to the entrainment, deposition, or transportation of sediments by currents of air or water.

KNAPPEN, T. T. See Campbell, F. B., 1.

KNERR, E. B.

1. The formation of Doniphan Lake, in the spring and early summer of 1891. *Kans. Acad. Sci., Trans.*, vol. 13, pp. 47-48, illus., 1891.

Describes the formation of a narrow lake by change in course of the Missouri River. States there was a yearly extension of bed in Missouri River north of Atchison until high water of 1891 cut a new channel across neck of ox-bow. The abandoned section of the channel became a lake 10 to 18 ft. deep.

KNIFFEN, FRED B.

1. Lower California studies IV. The national landscape of the Colorado Delta. *Calif. Univ., Pubs., Geog.*, vol. 5, no. 4, pp. 149-244, illus., Jan. 1932.

A detailed description of the various archtectonic activities of the Colorado Delta. Gives data on the silt burden of the Colorado River, and reports source of deposited delta alluvium and tributary contributions. Discusses the mechanics of stream flow as applied to such silt bearing streams as the Colorado. Considers the conditions of stream aggradation and degradation, meandering, bar formation, bank erosion, overbank flow, the building up of natural levees and the formation of secondary delta cones resulting from artificial diversion. Describes and classifies forms of the delta which owe their origin to the river and its deposited silt burden. Includes forms resulting from overflows and those produced by the interaction of sea and river waters. The characteristic vegetation pattern created within the delta area by the indirect action of the Colorado River is considered.

KNIGHT, CHARLES W.

1. Flood water channel of the Altoona, Pa., reservoirs. *Altoona, Pa., Water Dept. Ann. Rpt.*, pp. 25-35, illus., 1900.

Describes details of construction of a flood water channel at Kittanning Point, Altoona, Pa., to divert flood flows containing large quantities of sand, silt, and erosional debris from the upper and lower Kittanning reservoirs.

KNOPF, ADOLPH. See Longwell, C. R., 1.

KNOTT, C. G.

1. Mathematical note on the fall of small particles through liquid columns. *Roy. Soc. Edinb., Proc.*, (1915-16) vol. 36, pp. 237-239, 1916.

Presents in a simpler form the essence of Odén's mathematical discussion of the fall of small particles through a column of liquid as stated in his paper entitled The Size of Particles in Deep-Sea Deposits (Odén, S., 3).

KNOWLES, MORRIS.

1. Minority report of the Special committee on floods and flood prevention. Amer. Soc. Civ. Engin., Trans., vol. 81, pp. 1230-1234, 1917.

Report presented at the annual meeting of the American Society of Civil Engineers, Jan. 19, 1916. Suggests amendments to the majority report relative to proposed flood control measures, with special reference to the barrier system used to retain debris and prevent deposition in the main stream and to the levee system of channel storage. The utilization of reforestation, reservoirs and detention basins, channel enlargement, cut-offs, and outlets is also suggested.

KOCH, H. L. See Wentworth, C. K., 12.

KOELZER, VICTOR A. See also U. S. Interdepartmental Committee, 9.

1. (and Leopold, Luna B.): Science against silt.

Reclam. Era, vol. 33, no. 2, pp. 39-41, Feb. 1947.

Discusses briefly the sedimentation problem and the work by the Bureau of Reclamation to alleviate it. Comments on the desilting works for the All-American Canal in California, sedimentation in reservoirs, the sedimentation problem of the Middle Rio Grande, and laboratory investigations. Notes work of a special subcommittee of the Federal Inter-Agency River Basin Committee.

KORSTIAN, CLARENCE F. See Clapp, E. H., 2.

KOSMAN, M. See Lukirsky, P., 1.

KOTOK, E. I. See also Eaton, E. C., 1.

1. Solving the forest and water riddle. Amer. Forests, vol. 38, no. 9, pp. 488-491, illus., Sept. 1932.

Describes conditions of erosion in the various drainage basins of the United States and stresses the value of a vegetative cover on watersheds as an erosion-control and conservation measure. Surveys indicate that due to erosion Elephant Butte Reservoir lost 13 percent of its original capacity in a 17-yr. period, and that erosional activity will seriously jeopardize the Hoover Reservoir. Reports that erosional material from that portion of the watershed burned over in 1923, occupies 5.7 percent of the storage capacity of the Gibraltar Reservoir. The capacity of Arrowrock Reservoir due to watershed denudation has been reduced 6 percent.

KRAEBEL, C. J. See Barnes, F. F., 5; Eaton, E. C., 1; Hinds, N. E. A., 1.

KRAMER, HANS. See also Chang, Y. L., 1; Du Boys, M. P., 1; Engels, H., 3.

1. The practical application of the Du Boys' tractive-force theory. Amer. Geophys. Union, Trans., vol. 15, pt. 2, pp. 463-466, illus., June 1934.

Discusses an improved application of the Du Boys' theory for the analytical determination of the resisting-force of bed material in open channels. Presents a new formula, concerning the relation of critical tractive force of a sand mixture to its mechanical analysis which expresses the fact that the resistance of a mixture to movement, in addition to varying directly with grain size, also varies inversely with the voids ratio.

2. Sand mixtures and sand movement in fluvial models. Amer. Soc. Civ. Engin., Trans., vol. 100, pp. 798-838, illus., 1935; also in Amer. Soc. Civ. Engin., Proc., vol. 60, no. 4, pt. 1, pp. 443-483, illus., Apr. 1934; [abstract], Iowa Univ. Studies in Engin., Bul. 19, p. 57, May 1939.

Discusses model studies relative to the transportation of bed load in streams by traction. Reviews model-study of researches of Gilbert and of European hydraulicians and experiments by writer with fluvial models having moveable beds. Discusses use of bed-load mixtures in fluvial models, describing purpose, scope, and sequence of experiments. Describes details of model construction and measuring devices, and cites terminology used in experiments. Tabulates experimental data with reference to variations in slope, giving duration of flow, discharge, mean depth of water, surface velocity, Chezy coefficient c , tractive force, viscosity, and degree of bed-load movement and riffle formation. Discusses the limitations of the applicability of results to natural conditions.

Notes in conclusion the law of constant critical tractive force, effect of grain size and denseness on critical tractive force, effect of slope on limits of tractive force, effect of coarse mixtures on formation of riffles, and use of well-graded sand mixtures in fluvial models. Derives analytically and empirically a formula for computing tractive force as a function of character and size of grains. Discusses tractive force theory giving Du Boys' equation, derivation of a new formula, and application of formula to actual problems of river regulation. Discussion: JOHN LEIGHLY, pp. 839-841, comments on the substitution of hydraulic radius for that of depth in computing tractive force. Examines Kramer's experimental sand mixtures in terms of its mechanical composition, dissenting upon the "uniformity modulus" employed in Kramer's new hypothetical equation and the numerical value of the coefficient in the equation for several gradation curves. PAUL W. THOMPSON, pp. 842-844, considers the unsolved problem of the interrelation of the critical tractive force and the rate of bed-load movement. Examines possibilities of simulating in small scale models bed-load movement in streams. GERARD H. MATTHES, pp. 844-848, considers the application of the research work of Kramer and others in field of tractive force to Mississippi River problems. Describes a method for deriving Du Boys' formula. Reports the experimental work and results of model studies at the U. S. Waterways Experiment Station on prevailing slopes and depths, tractive force values, and critical tractive force required to move various types of bed-load material as applied to conditions in the lower Mississippi River. R. H. KEAYS, pp. 848-849, examines the practical application of model experiments on erosion and deposition to their prototypes in nature with reference to constancy of river slopes, tendency of alluvial streams to flow in a single channel, stream meandering, and erosion and deposition in stream channels. F. T. MAVIS, pp. 849-852, gives graphical representations of gradation data of sands used in moveable bed models, and the use of Chezy and Manning for formulas to express the relationship between velocity, depth, and slope in models. Notes observations by H. Wittmann relative to the effect of corrective engineering works on the bed-load movement of the Rhine River with reference to the use of Manning's n . C. C. TCHKOFF, pp. 852-858, comments on the theory of tractive forces as well as the quantitative transferability of experimental results with reference to laboratory investigations of bed-load movement. Believes limitations are of sufficient consequence to annul the entire theory. Discusses the contradictions between requirements for hydraulic similitude of channels and those satisfying the theory of tractive force. Analyzes hydraulic factors involved in some British Indian irrigation projects, in some alluvial canals, and in the Mississippi River in the United States. MORROUGH P. O'BRIEN, and BRUCE D. RINDLAUB, pp. 858-860, note briefly the relationship of rate of bed-load movement and tractive force, and discuss methods of computing tractive force. HERBERT D. VOGEL, pp. 860-861, outlines briefly conditions of similitude between fluvial models for bed-movement studies and natural conditions, and the reliability of Kramer's uniformity modulus. JOSEPH TIFFANY, JR., and CARL E. BENTZEL, pp. 861-867, describe briefly model investigations of bed-load movement at the U. S. Waterways Experiment Station at Vicksburg, Miss. Outline methods of determining the beginning of general bed-load movement, criteria for the conditions of general movement, and sequence of grain sizes set in motion. Examine Kramer's formula for tractive force and the relation between "uniformity modulus" and void ratio for sand mixtures. LORENZ G. STRAUB, pp. 867-872, analyzes with reference to transportability of bed load, possible relationship of resultant data based on use of

stream velocity and those data employing tractive force as a primary function. Describes model experiments conducted at the University of Minnesota on the characteristics of bed-load movement, giving results. THE AUTHOR, pp. 873-878, examines validity of Du Boys' formula for tractive force and analyzes the limitations for quantitative transferability of results of model experiments. Discusses the significance of the "uniformity modulus," and compares relative value of rate of bed-load movement and critical tractive force as factors in the application of experimental data to stream regulation. Comments briefly on conditions of similitude in models where cross-currents are negligible and in prototype (alluvial rivers), on the question of plotting gradation curves, and on the problems of bed-load movement from standpoint of kinetic flow factor. Discusses also on velocities, distribution throughout cross-section, and relation between "uniformity modulus" and void ratio.

KRESNIK, P.

1. Measures adopted for the safety and service of reservoir dams. *Engin. News*, vol. 23, no. 19, pp. 435-436, May 10, 1890.

Describes various measures adopted for safety and service of dams and appliances for drawing off water and cleaning reservoir of mud and sand by the construction of undersluices. Notes that amount of silt deposited in reservoirs depends primarily on catchment area, rainfall, and geological character of soil. Annual deposits in the Sig, Tielat, Djidonia and Habra Reservoirs in Algeria range from 0.16 to 1.6 cu. yd. per acre of catchment basin. Describes methods for removing deposited sediment from reservoirs.

KRIEGHBAUM, HILLIER.

1. Catching runaway land. *Today*, vol. 7, no. 11, pp. 20-21, 29, illus., Jan. 2, 1937.

Reviews various aspects of reservoir silting and gives suggestions for its control. Colorado River's annual silt load is 137,000 acre-feet. Lake Mead, behind Boulder Dam, contains from 5,000,000 to 8,000,000 acre-feet of storage space for silt, which space would be depleted in approximately 100 yr. Rate of silting in Elephant Butte Reservoir estimated at over 22,000 acre-feet annually. Probable life is about 100 yr. (Lowdermilk). Thirteen major reservoirs in the southern Piedmont region silted completely in 29.4 yr. Notes condition of scouring below Boulder Dam, also condition of desilting plant for the All-American Canal. In connection with the prevention of reservoir silting, discusses dredging of reservoirs, reservoir flushing noting conditions at Washington Mills Reservoir, Va., the use of silt-catch dams beyond headwaters of reservoirs, provision for silt storage in reservoirs, and the proper land usage.

KRIMGOLD, D. B. See Harrold, L. L., 4.
KRUCKMAN, ARNOLD.

1. Dam and channel will divert silt from entrance to Vancouver Harbor. *West. Construct. News*, vol. 18, no. 10, p. 468, Oct. 1943.

Discusses the features of a 300-foot pile and gravel dam which diverts the flow of Capilano River at Vancouver, B. C., to prevent further silting of the channel of Vancouver Harbor. In recent years due to silting, the entrance to Vancouver's Harbor has been narrowed about 250 ft. A channel dredged in 1939 filled up again during the next winter's flood season.

2. Flood control basins to be desilted by tunnel method. *West. Construct. News*, vol. 18, no. 10, p. 467, Oct. 1943.

Describes the 5-foot tunnel to be driven through Santa Anita Dam, Los Angeles, Calif., for sluicing out silt deposited by the floods of 1938 and 1943. Similar sluices proposed for Devils' Gate Dam. They may also be used on other dams of the county flood control system.

KRUMBEIN, W. C. See also Tyler, S. A., 1.

1. A history of the principles and methods of mechanical analysis. *Jour. Sedimentary Petrology*, vol. 2, no. 2, pp. 89-124, illus., Aug. 1932.

Presents an outline of the history of the techniques employed in the mechanical analysis of sediments, with particular reference to the principles and apparatus involved.

2. [Review of] *Die Schlämmanalyse* [Analysis by elutriation], by Hermann Gessner. *Jour. Sedimentary Petrology*, vol. 2, no. 2, p. 127, illus., Aug. 1932.

Describes Gessner's work (*Kolloidforschung in Einzeldarstellungen*, vol. 10, 244 pp., illus., 1931) which deals mainly with mechanical analysis. The book contains three chapters and an index. The first chapter deals with the settling of particles in fluids and the effects and causes of flocculation. The second chapter deals with descriptions of methods of mechanical analysis. The third chapter treats of the practice of mechanical analysis, discusses preparation of samples for analysis, gives a chart which displays steps involved in acquiring proper suspensions for the final analysis, and discusses choices of methods for particular types of material. The appendix gives tables of specific gravities, viscosities, etc.

3. The mechanical analysis of fine-grained sediments. *Jour. Sedimentary Petrology*, vol. 2, no. 3, pp. 140-149, Dec. 1932.

Discusses briefly the older methods of mechanical analysis and contrasts them with the newer ones. Describes the principles and application of the pipette method. Gives a standardized routine for the preparation of samples for analysis. Appends a flow sheet which indicates in graphic form the various steps in analyzing a sediment.

4. Correction of an error in "A history of the principles and methods of mechanical analysis." *Jour. Sedimentary Petrology*, vol. 3, no. 2, p. 95, Aug. 1933.

A correction of an error in A History of the Principles and Methods of Mechanical Analysis (Krumbein, W. C., 1). The error was an inaccurate statement concerning the use of Stokes' law of settling velocities.

5. The dispersion of fine-grained sediments for mechanical analysis. *Jour. Sedimentary Petrology*, vol. 3, no. 3, pp. 121-135, illus., Dec. 1933.

Deals with dispersion procedures for the mechanical analysis of fine-grained clastic sediments. Reviews earlier methods. Relates subject of dispersion to principles involved. Notes experimental comparison of procedures. Presents method for dispersion of fine-grained sediments. Gives sequence of routine in making analyses. Discusses application of method. Includes bibliography.

6. The probable error of sampling sediments for mechanical analysis. *Amer. Jour. Sci.*, vol. 27, no. 159, pp. 204-214, illus., Mar. 1934.

Discusses quantitatively the magnitude of errors in the sampling of sediments for mechanical analysis. Considers errors of mechanical analysis due to sampling, which is a function of the homogeneity of the sediment and the place and manner of collection, and those involved in the splitting and sieving processes.

7. Size frequency distribution of sediments. *Jour. Sedimentary Petrology*, vol. 4, no. 2, pp. 65-77, illus., Aug. 1934.

An explanation of the variations in shape of histograms (size frequency distribution of sediments) in contradistinction to cumulative curves. Presents a simple graphic method for obtaining from a given sample the unique frequency curve from the cumulative curve.

8. A time chart for mechanical analyses by the pipette method. *Jour. Sedimentary Petrology*, vol. 5, no. 2, pp. 93-95, illus., Aug. 1935.

Presents a chart, plotted on double logarithmic paper, showing as a linear function the relation between diameter and settling time for convenient use in making mechanical analyses of sediment by the pipette method.

9. Application of logarithmic moments to size-frequency distributions of sediments. *Jour. Sedimentary Petrology*, vol. 6, no. 1, pp. 35-47, illus., Apr. 1936.

- States that the disadvantages arising from the use of unequal class intervals in sedimentary analysis may be offset by substituting a new independent variable for usual diameter values. The use of this new independent variable makes available a series of statistical measures based on the moments of the distributions. Notes the advisability of using several techniques in the field of statistical analysis. The method of moments gives a means of supplementing the use of quartile measures.
10. [Review of] Studies of the morphological activity of river as illustrated by the River Fyris, by Filip Hjulström. *Jour. Sedimentary Petrology*, vol. 6, pp. 120-121, Aug. 1936.
A review of Studies of the Morphological Activity of Rivers as Illustrated by the River Fyris (Hjulström, F., 1). States that Hjulström discusses the problem of degradation of a river basin in connection with its environmental factors and the forces that control the processes of erosion and sedimentation. Includes discussion on laws governing the transportation and deposition of sediment.
 11. The use of quartile measures in describing and comparing sediments. *Amer. Jour. Sci.*, vol. 32, no. 188, pp. 98-111, illus., Aug. 1936.
Presents results of a study comparing a number of quartile measures and applying them to interpret frequency curve characteristics in the mechanical analyses of sediments. Application of writer's phi notation to quartile measures of several specific sediments is described.
 12. Rejoinder to Wentworth's discussion of the method of moments. *Jour. Sedimentary Petrology*, vol. 6, no. 3, pp. 159-160, Dec. 1936.
Comments on a discussion entitled The Method of Moments (Wentworth, C. K., 15). Attempts to clarify the relations between two papers concerned with Krumbein's and Wentworth's methods of moments in computing the constants of frequency distribution of particle size in sediments.
 13. Sediments and exponential curves. *Jour. Geol.*, vol. 45, no. 6, pp. 577-601, illus., Aug./Sept. 1937.
Discusses several sedimentary situations in which there is a strong suggestion that negative exponential functions are involved. Determines controlling coefficients and summarizes the implications of the exponential function as applied to geology. Suggests that laws of probability play a part in determining exponential functions.
 14. (and Pettijohn, F. J.). *Manual of sedimentary petrography*. 549 pp., illus. New York, D. Appleton-Century Co. Inc., 1938.
Divided into two parts; the first part by W. C. Krumbein deals with sampling, preparation for analysis, mechanical analysis, and statistical analysis, etc. The second part by F. J. Pettijohn treats shape analysis, mineralogical analysis, chemical analysis, and mass properties, etc. Microscopic identification of minerals in sedimentary materials is described. Comments on design for a sedimentological laboratory and various equipment needed.
 15. Size frequency distributions of sediments and the normal phi curve. *Jour. Sedimentary Petrology*, vol. 8, no. 3, pp. 84-90, Dec. 1938.
Indicates the usefulness of logarithmic moments of mechanical analysis data to aid in studies of environmental factors affecting the transportation and deposition of sediments.
 16. Graphic presentation and statistical analysis of sedimentary data. In Trask, P. D., ed. *Recent marine sediments; a symposium*, pp. 558-591, illus. London, T. Murby and Co., 1939.
Demonstrates the applicability of graphic presentation and statistical analysis of sedimentary data with particular reference to data on mechanical analysis. Methods of presentation, description, and comparison of sediments are discussed in detail. The choice of mathematical methods to simplify statistical approach, the use of new independent variables for diameters of sedimentary particles, and theoretical implications of new approach are considered.
 17. Preferred orientation of pebbles in sedimentary deposits. *Jour. Geol.*, vol. 47, pp. 673-706, illus., 1939.
Describes methods used in collecting and measuring pebbles which are from glacial till, outwash terrace, or from a beach. Discusses methods of plotting data such as petro-fabric diagrams, polar co-ordinate charts, and histograms. Statistical analysis of the data affords data for comparative studies of size, shape, and other attributes with preferred orientation. Isopleth maps showing areal variations of preferred orientation can be developed.
 18. Tidal lagoon sediments on the Mississippi Delta. In Trask, P. D., ed. *Recent marine sediments; a symposium*, pp. 178-194, illus. London, T. Murby and Co., 1939.
Describes the sediments in Barataria Bay, a tidal lagoon at the edge of the Mississippi Delta, and shows by means of isopleth maps that the characteristics of the sediments reflect conditions of their formation and vary with varying conditions in the environment. Describes sampling locality and mechanical and chemical analysis of sediments. Presents graphical and statistical analysis of data. Literature is cited.
 19. Settling velocity and the orientation of sedimentary particles. 8 pp. [Washington Natl. Bur. Standards], 1939.
Round-table discussion on The Role of Hydraulic Laboratories in Geophysical Research, at National Bureau of Standards, Sept. 13, 1939. Discusses settling velocity and orientation in general. Comments on four subjects: the settling velocity of spheres, the influence of shape and orientation on settling velocity, orientation during transport, and orientation after deposition. Gives Stokes' and other laws pertaining to this field.
 20. Application of photo-electric cell to the measurement of pebble axes for orientation analysis. *Jour. Sedimentary Petrology*, vol. 9, no. 3, pp. 122-130, illus., Dec. 1939.
Reviews methods for expressing the size of sedimentary particles. Describes a photocell apparatus used for making studies of pebble orientation for the measurement of pebble axes in order to determine the statistical distribution of the several axes in space, and as they occur in the original deposit.
 21. (and Tisdell, F. W.). Size distributions of source rocks of sediment. *Amer. Jour. Sci.*, vol. 238, no. 4, pp. 296-305, illus., Apr. 1940.
Subjects five samples of mechanically disintegrated igneous rocks and two samples of chemically weathered igneous rocks to mechanical analysis. The size-frequency distribution curves show a similarity between these particles and particles of transported sedimentary material. Notes that the degree of sorting is commensurate with sediments, and the skewness of distributions is reversed as compared to coarse sediments.
 22. Flood gravel of San Gabriel Canyon, California. *Geol. Soc. Amer. Bul.*, vol. 51, no. 5, pp. 639-676, illus., May 1, 1940; [abstract], *Geol. Soc. Amer. Bul.*, vol. 50, no. 12, p. 1918, Dec. 1, 1918.
Describes the characteristics of flood sediments deposited in the San Gabriel Canyon during the flood of Mar. 2, 1938. The collection, description and laboratory analysis of samples are reported. Describes how size, shape, roundness, lithology, and fabric of the gravel vary as functions of distance along the valley and relates changes to the physical processes which occurred during the flood.
 23. The effects of abrasion on the size, shape, and roundness of rock fragments. *Jour. Geol.*, vol. 49, no. 5, pp. 482, 520, illus., July/Aug. 1941.
Deals with the inter-relations which exist among size, shape, and roundness of particles in the pebble and cobble range under conditions of abrasion. Experimental data are presented and relative rates of size reduction, rounding, and change in shape are determined. An analytical theory of abrasion is developed.
 24. Measurement and geological significance of shape and roundness of sedimentary particles. *Jour.*

- Sedimentary Petrology, vol. 11, no. 2, pp. 64-72, illus., Aug. 1941.
Describes methods for the rapid measurement of shape and roundness of large sedimentary particles. Treats importance of shape and roundness in sedimentary studies.
25. Corrigenda for "Measurement and geological significance of shape and roundness of sedimentary particles." Jour. Sedimentary Petrology, vol. 11, no. 3, p. 148, Dec. 1941.
Gives several corrections for the paper entitled Measurement and Geological Significance of Shape and Roundness of Sedimentary Particles (Krumbein, W. C., 25).
 26. Statistical summary of alluvial gravels. Natl. Res. Council, Div. Geol. and Geog., Com. on Sedimentation Rpt. (1940-41), Exhibit B, pp. 9-14, tables, Mar. 1942.
Presents statistical data on some alluvial gravels. Includes a chart giving statistical parameters of 100 samples of fluvial gravel.
 27. Flood deposits of Arroyo Seco, Los Angeles County, California. Geol. Soc. Amer. Bul., vol. 53, pp. 1355-1402, illus., Sept. 1, 1942.
A continuation of an earlier study made by the author on the flood deposits of San Gabriel Canyon due to the flood of Mar. 2, 1938. Flood deposits in the Arroyo Seco left by the flood are mapped and sedimentary characteristics of samples determined. Results show that size and shape respond to dynamical conditions at immediate deposition site, and that roundness of particles is due to abrasion caused by the distances traveled. Reports attempts to reconstruct physical conditions governing deposition and movement of flood deposits. Evaluates the relative effects of selective transportation and wear during time of floods.
 28. Settling-velocities and flume-behavior of non-spherical particles. Amer. Geophys. Union, Trans., vol. 23, pt. 2, pp. 621-632, illus., Nov. 1942.
The effect of shape on particle-transportation in flumes is tested and relates the behavior to the settling-velocities of the particles. Data are concerned with the bed-movement of single particles of different shapes. Results show the order of magnitude of the shape-factor and indicate that this factor may be as important as size in stream transportation.
Discussion: A. A. KALINSKE, pp. 632-633, notes that the Froude number of the channel-flow has no physical significance to bed-load movement. Makes other comments on the author's equations, etc. States that the data regarding settling velocity will cause simplification of analyses of sediment movement.
 29. Fundamental attributes of sedimentary particles. Iowa Univ. Studies in Engin., Bul. 27, pp. 318-331, illus., 1943.
Considers fundamental sedimentary particle properties such as geometrical, crystallographic, optical, chemical, mechanical, thermal, electrical, and magnetic. Comments on the properties of sedimentary aggregates. Notes that the volume of sediments in a reservoir is a function in part of particle orientation, the bulk volume being greater than preferred orientation. States that the principles of sediment transportation and deposition are common to hydraulic engineering and geology.
- KRYNINE, D. P.
1. Some engineering aspects of river sand deposits. Econ. Geol., vol. 39, no. 4, pp. 307-314, illus., June/July 1944.
Article shows how the coarseness of sand at different sections of a river may be approximately and quickly defined by a single numerical value, without the use of size-distribution or cumulative curves. Considers the particular case of the Thames River bed in New London, Conn. Includes some field observations on the compactness of river sand deposits.
- KRYNINE, PAUL D.
1. Arkose deposits in the humid tropics: a study of sedimentation in southern Mexico. Amer. Jour. Sci., (ser. 5) vol. 29, pp. 353-363, illus., Apr. 1935.
Describes the arkose deposits of southern Mexico and discusses their origin and formative processes. The influences of climate and topography in the formation and distribution of the deposits are considered.
2. Geomorphology and sedimentation in the humid tropics. Amer. Jour. Sci., (ser. 5) vol. 32, no. 190, pp. 297-306, Oct. 1936.
Reviews and discusses a paper entitled Geomorphologie der feuchten Tropen, by Karl Sapper (Geographische Schriften, Heft 7, Leipzig-Berlin, 1935). Includes a discussion on conditions of erosion and the transportation and deposition of erosional detritus in the humid tropics.
 3. The megascopic study and field classification of sedimentary rocks. Jour. Geol., vol. 56, no. 2, pp. 130-165, illus., Mar. 1948.
Presents a simplified form of rock classification based on mineral composition and texture. Defines basic terms and fundamentals of composition, texture, and structure. Treats the three major series of sedimentary rocks. Gives principles of applied petrographic nomenclature and use of proposed classification table.
- KUCINSKI, KAROL J.
1. (and Eisenmenger, Walter S.). An investigation of the source and nature of erosional damage on alluvial soils of Massachusetts. Mass. Agr. Expt. Sta. Bul. 369, pp. 12-13, Feb. 1940.
Results of a study of sources and extent of damages to alluvial soils resulting from floods of 1936 and 1938 of the Connecticut, Merri-mack, and other Rivers of Massachusetts. Notes the effects of silt deposition on agricultural lands.
- KUENEN, PH. H.
1. Experiments in connection with Daly's Hypothesis on the formation of submarine canyons. Leidsche Geol. Meded., vol. 8, no. 2, pp. 327-351, 1937.
Comments on various hypotheses to explain the formation of submarine canyons. Discusses experiments at the Leyden University which substantiate Daly's hypothesis in relation to the idea of density stratification on the erosion of submarine canyons by submarine currents containing a suspension of sediment.
 2. Density currents in connection with the problem of submarine canyons. Geol. Mag., vol. 75, no. 6, pp. 241-249, June 1938.
A paper relative to density currents as a contributing element in the development of submarine canyons. Presents Daly's theory of origin of submarine canyons, and describes Kuenen's experiments to test general validity of Daly's principle. Discusses the underflow of density currents in Lake Mead and Elephant Butte Reservoir and its relevancy to Daly's quantitative hypothesis pertaining to submarine canyons. Remarks upon the influence the density stratification of the oceans have on the development of submarine canyons, and notes that reservoirs and lakes are as a rule immune to such inducement. Offers an extensive bibliography.
- KUNSMAN, HOWARD SMITH.
1. Stream and valley sedimentation in Beaver Creek Valley, Wisconsin. 134 pp., illus., tables and graphs, 1944. Unpublished thesis (M. Ph.) — University of Wisconsin.
An investigation to determine the effects of accelerated sedimentation as shown by sediments deposited during the period of accelerated erosion in the main valley of Beaver Creek, South Fork, and French Creek, Wis. Test borings were used to determine thickness and character of modern flood-plain deposits. Gives data on suspended-load sampling at Lake Marinuka, Galesville, Wis. Includes data on reservoir sedimentation at Lake Marinuka and Ettrick Millpond.
- LABELLE, H. F.
1. Silting up of reservoirs [letter to editor]. Engin. News, vol. 60, no. 8, pp. 211-212, Aug. 20, 1908.
Answer to C. H. H.'s query relative to silting of old reservoirs (Engin. News, vol. 60, July 23, 1908). Refers to T. U. Taylor's paper on the Austin Dam (Taylor, T. U., 1), noting

that from 1893 to 1897 the reservoir behind Austin Dam silted up about 38 percent of its original capacity and by 1900 the reservoir had silted up 48 percent, and that if the dam had remained intact, the depth of silt by 1909 would have reached 48 ft., after which it is believed the progress of silting would have been very small. Gives as the reason for this belief the conditions at many ancient "tanks" in India which have silted up completely and which now act as diversion instead of storage dams. Discusses the value of undersluices in preventing reservoir silting and describes conditions at 43 masonry irrigation dams in the Province of Cavite, Philippine Islands, where all but a few of the dams have undersluices. A remarkable instance of the usefulness of undersluices is Bhatgarh Reservoir described by Buckley in "Irrigation Work of India." This reservoir is equipped with 15 undersluices and has silted less than 0.1 percent in 12 yr. even though Yellrandi River, which supplies the reservoir, carries as much as 1 in 100 parts of silt. Discusses the rate of reservoir silting as a function of velocity, silt content of stream, shape of reservoir, and height of dam, noting that if the reservoir at Austin had no intake below the crest of the dam, the reservoir would have silted up 98 percent by the 40th yr. with the rate of silting at that time being less than 0.2 percent per year. Notes similar conditions at Cavite reservoirs. Discusses the use of subsidiary dams above the reservoir as a remedy against silting, and the effect of reservoir silting on appurtenant works.

LACEY, GERALD. See also Gopalakrishnan, C., 1; Griffith, W. M., 1, 2; Lane, E. W., 4; Anonymous, 176.

1. Stable channels in alluvium. *Inst. Civ. Engin., Minutes of Proc.*, vol. 229, pp. 259-292, illus., 1930; [abstract], *Engineering*, vol. 129, pp. 179-180, Feb. 1930.
Describes the transportation of silt by stable channels in erodible material. Gives Kennedy's, Lindley's, and Madras' formulas for V_0 (critical velocity) as a function of depth and type of silt transported, also amended formula considering R (mean hydraulic depth) instead of D (depth). Describes use of silt factor. Gives principle governing stable channels in alluvium, namely, all stable silt-transporting channels of the same velocity assume the same shape, and if they have the same discharge, they will have the same wetted perimeter irrespective of type of silt carried. Applies the formulae to large rivers to determine scour through bridges.
2. Uniform flow in alluvial rivers and canals. *Inst. Civ. Engin., Minutes of Proc.*, vol. 237, pp. 421-453, illus., tables, 1935; [abstract], *Surveyor and Munic. and Co. Engin.*, vol. 84, no. 2185, p. 540, illus., Dec. 8, 1933.
Collates a large amount of observations from canals and rivers and derives by analysis a general flow theory applicable to channels with uniform flow in incoherent alluvium. Presents flow formulas for régime canals. Gives a régime chart, so that observers may test its accuracy without assessing silt grade. States that the materials of the active wetted surface form the basic control and that the rugosity of the channel depends upon their average size. Summarizes various conclusions reached. Presents a more rigid analysis of a general theory of flow applicable to channels flowing uniformly in incoherent alluvium than in a previous paper, *Stable Channels in Alluvium* (Lacey, G., 1).
3. Note of regime flow. *India Cent. Bd. Irrig. Pub.* 11, pp. 73-75, illus., 1936.
Explains briefly the derivation of the author's formulas relative to his theory of regime flow. Illustrates the practical significance of theory.
4. An improved regime slope formula. *India Cent. Bd. Irrig. Pub.* 14, pp. 123-124, 1937.
A note in which writer presents a more accurate type of equation for regime slope.

5. Viscosity as a factor in the flow of water in open channels. *India Cent. Bd. Irrig. Pub.* 14, pp. 117-119, 1937.

Deals with viscosity as a factor in the ordinary turbulent flow of water in open channels in alluvium.

6. Tidal models [letter to editor]. *Water and Water Engin.*, vol. 39, no. 478, pp. 276-277, May 1937.
Comments on a description of the tidal model of the River Great Ouse and the Wash (Borer, O., 1). Includes discussion on conditions necessary to reproduce river erosive and silting action in the model.
7. Limiting regime discharges [letter to editor]. *Indian Engin.*, vol. 102, no. 2, p. 54, Aug. 1937.
Presents additional information on the derivation of formulae for determining limiting discharge given in a previous paper (Lacey, G., 1).
8. Kutter-Kennedy regime channels [letter to editor]. *Indian Engin.*, vol. 103, no. 6, pp. 189-190, June 1938.

Notes a discussion (Bellasis, E. S., 3) on the attitude of engineers in India on regime design. Discusses the Kutter and Kennedy formulas of regime design. Believes the Manning equation is a better equation for regime design than that of Kutter.

9. General flow formulae [letter to editor]. *Indian Engin.*, vol. 106, p. 181, Dec. 1939.
Compares his formula of flow in alluvial channels published in 1930 with Khanna's equation (Khanna, R. K., 8). Credits Khanna with the original contribution of the theory of silt transport of a soil factor, in place of author's silt factor. Comments on other criticisms which Khanna levels at writer's silt theory.
10. Regime flow in incoherent alluvium. *India Cent. Bd. Irrig. Pub.* 20, 65 pp., illus., 1940.
Describes the background against which perfect regime flow as a mathematical and physical concept must be regarded, and presents his equations of regime flow, developed over a period of 10 yr., in a sequence that lends itself to logical treatment.
11. The effective width and depth of regime channels. *India Cent. Bd. Irrig. Pub.* 29, pp. 78-81, 1943.
Expressions for the effective width and depth of regime channels are given. The effect of berming is noted, and it is shown W_b is an unsuitable variable for bed silt grade equations. The introduction of W and D in the regime equations is discussed.
12. The selection of alluvial model scales. *India Cent. Bd. Irrig. Pub.* 29, pp. 91-96, 1943.
Discusses the factors governing the selection of scales in alluvial models with sandy beds, and basic equations produced for the computation of model scales. Means of computing degree of tilting are stated.
13. A general theory of flow in alluvium. *Inst. Civ. Engin. Jour.*, vol. 27, no. 1, pp. 16-47, tables and graphs, Nov. 1946.
Shows that certain of the author's previous equations apply to regime and non-regime channels alike. Notes the reconciliation of discordant data by taking into account the variables of silt charge and "shock." Regroups the fundamental variables of velocity, depth, and water-surface slope. Obtains two new parameters from which a normal equation applicable to all active alluvial channels in steady flow is derived. Presents an equation of the Manning type.

LACEY, JOSEPH MELVILLE. See also Griffith, W. M., 1.

1. Some problems connected with the rivers and the canals in southern India. *Inst. Civ. Engin., Minutes of Proc.*, vol. 216, pp. 150-160, illus., 1923; [abstract], *Engineering*, vol. 115, no. 2984, p. 113, Mar. 9, 1923.
Discusses the regimen of streams and canals of South India with particular reference to problems of control. Describes conditions of erosion and the transportation and deposition of sands, and notes necessary surveys for any systematic scheme for the conservancy and control of streams. Considers factors involved in marginal erosion, the effect of flood embankments on the deltaic portions of streams, fac-

- tors affecting and conditions of silt transportation and deposition in canals, and means of excluding and clearing silt from canals.
2. Flowing water. I. Engineer, vol. 149, pp. 571-573, illus., May 23, 1930.
Discusses the characteristics of flowing water in open channels in alluvium. Includes discussion on marginal erosion and on deposition and scour from observations at Sukkur and Kotri, India.
 3. Flowing water. III. Engineer, vol. 150, pp. 218-220, illus., Aug. 29, 1930.
Deals with the problem of determining the amount of opening or waterway to be given to a bridge or culvert to avoid bed deepening by scour. Bed and bank training and regulation, and contraction works are dealt with.
 4. Flowing water. IV. Engineer, vol. 152, pp. 3-5, illus., July 3, 1931.
Discusses the various factors to be considered in the design of canals and canal headworks to prevent silt deposition.
 5. Flowing water. V. Engineer, vol. 152, pp. 508-509, illus., Nov. 13, 1931.
Deals with the design of irrigation canals. Includes discussion on factors to be considered to prevent erosion and silting in canals.
 6. Flowing water. VI. Engineer, vol. 153, pp. 604-606, illus., June 3, 1932.
Describes different systems of irrigation employed in various countries and climates. Gives a brief description of the character of the alluvial soils in the deltas of the Godavary and Kistna Rivers in South India, and notes the effect of sediment deposition upon the character of the soils.
- LADD, GEORGE E.
1. Geological phenomena resulting from the surface tension of water. Amer. Geol., vol. 22, no. 5, pp. 267-285, illus., Nov. 1898.
Describes the phenomena of shrinkage and consolidation of clays, flocculation, and the flotation of materials resulting from the surface tension of water.
- LADD, H. S. See Wentworth, C. K., 10.
- LADNER, GROVER C. See Elis, M. M., 2.
- LAIDSHAW, G. E.
1. The effect on meadow lands of back water from dams [letter to editor and enclosure]. Engin. News, vol. 48, no. 16, pp. 316-317, illus., Oct. 16, 1902.
Answers query by S. P. D. on the effect of backwater from dams on meadow lands (Engin. News, Sept. 11, 1902). Cites Supreme Court case involving hydraulic principle of the movement of silt and sand in the channel, or trace of a stream, and capillary action. Illustration showing original gradient and position of shoals on Lawson's Fork Creek, S. C., prior to erection of Wingo's Mill Pond dam, fill in stream due to obstruction caused by dam, and scour in stream due to break in dam.
- LAHMER, J. A.
1. River protection work on the Kansas City Southern Railway, near Braden, Okla. Amer. Soc. Civ. Engin., Trans., vol. 66, pp. 387-394, illus., 1910.
Describes the construction of a system of brush dikes by the Kansas City Southern Ry. to prevent erosion of the concave bank of the Arkansas River near Braden, Okla.
- LAINÉ, E. See Müntz, A., 1, 2, 3.
- LAIRD, FRED W.
1. Sedimentation of colloidal particles. Jour. Phys. Chem., vol. 31, pp. 1034-1049, illus., July/Dec. 1927.
Discusses various conceptions of sedimentation equilibrium as applied to colloidal suspensions.
- LAKIN, H. W. See Olmstead, L. B., 2.
- LAMAR, J. E.
1. (and Grim, R. E.). Heavy minerals in Illinois sands and gravels of various ages. Jour. Sedimentary Petrology, vol. 7, no. 2, pp. 78-83, illus., Aug. 1937.
Consists of studies of heavy minerals in 9 samples of Recent sand, 18 samples of Glacial sand, and 8 samples of Cretaceous sand. Notes the heavy minerals which characterize Glacial sands, Recent lake and river sands derived from glacial deposits, and Cretaceous sands.
- LAMAR, WILLIAM L.
1. Chemical character of surface waters of Georgia. U. S. Geol. Survey, Water-Supply Paper 889-E, pp. 317-380, 1944.
Gives information on the character of surface waters of Georgia as shown by 470 analyses of samples collected from 96 sampling points. Includes data on the suspended matter in various streams in Georgia.
- LAMB, HORACE.
1. On the uniform motion of a sphere through a viscous fluid. London, Edinb. and Dublin Phil. Mag. and Jour. Sci., (ser. 6) vol. 21, no. 121, pp. 112-121, Jan. 1911.
A mathematical treatment of the uniform motion of a sphere through a viscous fluid. Comments on an analysis of the problem by Prof. C. W. Oseen.
- LAMBERT, RAYMOND H.
1. (and Wightman, E. P.). Automatic recorder for measuring size frequency distribution of grains. Optical Soc. Amer. Jour., vol. 11, no. 4, pp. 393-402, illus., Oct. 1925.
Describes a simple automatic photographic method for determining weight or size-frequency distribution of particles in a sedimenting liquid. Works out a method of correcting an important error in the Ostwald-Hahn-Kelly sedimentation process.
- LA MOTTE, R. S. See Barnes, F. F., 5.
- LAMP, GEORGE C.
1. Flood control on the Little Sioux. Soil Conserv., vol. 12, pp. 219-222, illus., May 1947.
Deals with the program of the U. S. Soil Conservation Service and the U. S. Corps of Engineers to solve the problem of recurrent flooding on the Little Sioux in northwestern Iowa. Treats of sediment damage and methods to reduce sedimentation. Notes that stream-channel meanders caused by floods create damage.
- LANCEFIELD, R. L. See Blue, F. L., Jr., 1.
- LANE, D. A.
1. Artificial groundwater. Engin. News-Rec., vol. 116, pp. 779-780, illus., May 28, 1936.
Deals with an artificial groundwater supply for Los Angeles at Tujunga obtained by flooding water over spreading ground in basins between dikes. The water percolates into an absorbent strata exposed by excavating the topsoil and silt. Flood waters in 1934 entered San Fernando Reservoir laden with silt so that when the surplus water was put through the spreading ground the rate of percolation dropped because of the sealing effect of the silt. By frequent cultivation of the ground, but without removal of the silt, the usual clear water percolation rate of 6 ft. per day was regained. Construction details and a note on the necessity and value of the spreading grounds are included.
- LANE, E. W. See also Campbell, F. B., 1; Chang, Y. L., 1; Eliassen, S., 4; Griffith, W. M., 2; Howard, C. S., 8; Kelly, W., 1; Salisbury, E. F., 1; Shaw, A. M., 3; Stevens, J. S., 2, 6; Todd, O. J., 10; Whipple, W., Jr., 1; U. S. Interdepartmental Committee, 9.
1. Controlling floods in China. Civ. Engin., vol. 1, no. 3, pp. 165-170, illus., Dec. 1930.
Describes floods and silting of the Yellow River, including historical background of dams, dikes, and levee construction, and method of desilting the Grand Canal by hand excavation using cheap labor. The Yellow River carries as much as 10 percent silt which fills up the river bed causing overflow of dikes, breaks in dikes, and eventually a new river channel. The Yellow River broke through a levee to join the Hual River prior to 1194. The combined river was prevented from joining the Yangtze River by the Great Di. In 1851 the Yellow River again changed its course after filling its bed with silt and left two ridges of silt 1-5 miles apart which represent the old river channels.
 2. Progress report No. 1 on study of non-silting, non-scouring canal sections for the All-American Canal. U. S. Bur. Reclam., Denver, Colo., Tech. Memo. 349, 28 pp., illus., Sept. 7, 1933.
Outlines the main principles which control stable channel shapes and velocities. Gives results of studies made on the problem of select-

- ing a non-silting canal section for the All-American Canal. Includes a history of non-silting canal section studies.
3. Retrogression of levels in riverbeds below dams. *Engin. News-Rec.*, vol. 112, no. 26, pp. 836-838, June 28, 1934; also in *Assoc. Chinese and Amer. Engin. Jour.*, vol. 16, no. 1, pp. 16-23, Jan./Feb. 1935.

Studies by the U. S. Bureau of Reclamation to determine the effect of the phenomena of retrogression of bed levels below dams upon the design of the power plant at Boulder Dam. Describes river-bed conditions and effect of retrogression below weirs of Sutlej Valley Project, India, Yuba River mining debris barrier near Marysville, Calif., at Junction plant on Manistee River, Mich., at Foote Dam on Au Sable River, Mich., and at an unnamed dam on the Wisconsin River in Wisconsin. Gives rate of sedimentation of the Yuba River debris barrier and notes that deposits brought by the flood were composed of 0.6 percent less than 80-mesh-per-in. size, 1.8 percent less than 8 mesh-per-in. size, the remainder ranging up to boulders 1 ft. in diameter, the greater part being relatively fine material. Gives observations on the recession of river levels below Elephant Butte Dam on the Rio Grande, noting that the average silt content of the river is 1.65 percent and at Laguna Dam on the Colorado River, where retrogression largely disappeared after a 20,000-acre-foot pond was practically filled the first year and flow of silt was re-established. Notes observations in Germany. Gives conclusions and discusses possible use of the phenomena of retrogression below dams for flood control.

4. Stable channels in erodible material. *Amer. Soc. Civ. Engin., Trans.*, vol. 102, pp. 123-142, illus., 1937; also in *Amer. Soc. Civ. Engin., Proc.*, vol. 61, no. 9, pp. 1307-1326, illus., Nov. 1935; [abstract], *Iowa Univ., Studies in Engin., Bul.* 19, p. 59, May 1939.

Outlines the major principles involved in the control of stable channels. Describes the regimen of the proposed All-American Canal, noting the silt content and character of silt in Colorado River water near the intake of the proposed canal; and the effect of dams above the intake and desilting works in reducing sediment load entering the canal. Cites previous studies by Kennedy, Woods, Lindley, Bottomley, Lacey, Buckley, and others on nonscouring canal sections. Summarizes previous stable channel formulas, and compares available data on critical velocities and formulas for width-depth relation in order to develop a rational design for the All-American Canal sections. Factors in the determination of stable channel shapes are discussed, noting particularly those relative to size, shape, specific gravity, and quantity of material transported. Conditions for channel stability for the transportation of clear water, water-carrying solids in suspension, and channels carrying bed load are discussed. The effect of colloids carried in water on the shape of channel cross-section is noted, together with stable channel shapes, and the effect of variations in the velocity of flow.

Discussion: R. C. JOHNSON, pp. 143-144, notes observations on conditions of erosion and silting in drainage channels constructed by U. S. Soil Conservation Service in the Piedmont section of South Carolina, 1935. Cites the inapplicability to these channels of Kennedy's formula for critical velocity and the suitability, as a guide, of the permissible canal velocities of Fortier and Scobey (Fortier, S., 2). E. S. LINDLEY, pp. 144-145, considers various factors, noting in particular the silt factor involved in the design of a channel. J. C. STEVENS, pp. 145-149, notes that differences in behavior of the Egyptian, Indian, and American canals are probably due to the differences in the character of alluvium. Discusses the effect of colloids and fine clay in alluvium on the stability of streams flowing through it. Lists the properties of canals flowing through their own

alluvium (based on Lacey's formula) and notes the conformity to this formula in certain alluvial channels. States the rational method of designing non-silting and non-scouring canals. C. R. PETTIS, pp. 149-152, considers the determinations made by Lane on the various elements involved in channel stability as applied to rivers and determinations made by Lacey relative to canal stability. HARRY F. BLANEY, pp. 152-153, notes investigation by himself and Fortier with reference to the co-ordination of laws governing silt movement in the Colorado River and the Imperial canals, with laws applicable to other streams (Fortier, S., 3). Compares the gradation of silt deposits of the Imperial Canal with those of Sirhind Canal, India. SIGURD ELIASSEN, pp. 154-157, reports that the stability in channels of North China is made difficult by the enormous silt loads of streams. Data on Yellow River silt load are given and the importance of the quantity and quality of bed load as factors in discussing channel stability is noted. Data are presented on the conditions of silt transportation and deposition, mechanical analysis of silt in the Wei Pei main irrigation canal, and the scouring and depositing of silt as factors influencing channel efficiency. Examines the Kennedy and Chezy-Kutter formulas as affected by variations in the silt load and manner of silt transportation. R. E. BALLESTER, pp. 157-159, presents additional data observed in the Rio Negro system, Argentina, to confirm Lane's formula for non-scouring and non-silting velocities. Gives an analysis of silt and bottom soil in main channel of the Rio Negro system. GERALD LACEY, pp. 159-164, mentions factors involved in the design of channels which flow in an unlimited alluvial plain of the same silt grade as that transported, and channels which flow uniformly in incoherent alluvium. Considers the importance of the silt factor and flume traction in the design of Colorado River canals. Examines briefly the energetics of the transportation of silt in suspension. Factors affecting channel behavior as dimensioned variables are discussed. Formulas are given. V. V. TCHIKOFF, pp. 164-179, mentions hydraulic factors governing channel stability, discusses "isovels," velocity gradient, pressure gradient, kinetic factor, sediment equivalent, quantity and quality of sediment, relationship of kinetic factor and silt equivalent, degree of suspended and bed sediment concentration, coefficient of hydraulic similitude and hydraulic number, and width-depth ratio. Presents data on general hydraulic factors in stable canals in Imperial Valley, Calif. (Collings). Notes the influence of fine particles on scouring, the limits in a non-silting channel, and the stability in channels of variable discharge. Application to the All-American Canal is made. W. M. GRIFFITH, pp. 179-185, notes the relationship between channel shape and transported silt loads. Considers theories of silt transportation and hydraulic conditions governing stable channels outlined by Kennedy, Lacey, and himself. Presents hydraulic data relative to different channel sections and to efficient silt-carrying capacity. THE AUTHOR, pp. 185-194, regarding the phenomena of stable channel shapes, comments on previous discussions by Lacey, Stevens, Eliassen, Ballester, Lindley, Griffith, Tchikoff, and Blaney relative to the hydraulic factors involved in stable channels. Discusses factors of flume traction, concentration of silt load, movement of bed material, silt-carrying ability, quality and quantity of silt, "sediment equivalent," isovels, velocity gradient; and the relation between the discharge and total silt load with reference to the transportation and deposition of sediment. Data on the All-American Canal sections are presented.

5. Hydraulic progress. *Engin. News-Rec.*, vol. 118, pp. 174-176, Feb. 4, 1937.

An annual progress report on hydraulics for the year 1936, noting growth of hydraulic laboratories and model testing. Treats tidal models at

- U. S. Waterways Experiment Station (Vicksburg), Massachusetts Institute of Technology, and University of California, and materials that will reproduce bed movement with the relatively feeble currents of tidal models. Discusses work of Straub, O'Brien, and the U. S. Soil Conservation Service on the transportation of solids by flowing water. Notes progress in dam design and hydrology.
6. Collection of data on the solids load of flowing streams. Assoc. Chinese and Amer. Engin. Jour., vol. 19, no. 3, pp. 151-161, illus., May/June 1938; [abstract], Iowa Univ., Studies in Engin., Bul. 19, p. 59, May 1939.
Describes methods of collecting data on suspended and bed load of flowing streams. Discusses methods of stream transportation of suspended and bed loads. Gives methods of sampling to determine magnitude and character of suspended and bed loads in relation to variations in discharge and distribution of solids in stream cross-sections. Describes and gives illustrations of numerous types of sampling devices to determine the quantity and quality of material carried in suspension and as bed load.
 7. Notes on the formation of sand. Amer. Geophys. Union, Trans., vol. 19, pt. 1, pp. 505-508, illus., Aug. 1938; [abstract], Iowa Univ., Studies in Engin., Bul. 19, p. 57, May 1939.
Deals with the characteristics of stream-bed materials and the cause of uniformity in grain size of particles composing stream bed. Presents chart showing the mechanical analyses of samples from various river beds. Discusses the laws governing and factors affecting the rate of settling of spheres in a fluid as a possible explanation of phenomena relative to the formation of sand in rivers.
 8. Final report on sedimentation above the Caddoa Dam on the Arkansas River in Colorado. 54 pp., illus. Apr. 10, 1939.
Deals with sedimentation which will occur above Caddoa Dam due to the construction of the dam. Discusses deposition in Caddoa Reservoir. Includes suspended load data on the Arkansas River. Considers methods used in computing the location of deposits in the Caddoa Reservoir. Compares Elephant Butte and Caddoa Reservoirs.
 9. (and Kalinske, A. A.). The relation of suspended to bed material in rivers. Amer. Geophys. Union, Trans., vol. 20, pt. 4, pp. 637-641, illus., Aug. 1939.
The relation of suspended material to stream-bed composition and hydraulic characteristics of a river is developed.
 10. Engineering aspects of sediment transportation. Iowa Engin. Soc., Proc., vol. 14, no. 4, pp. 91-103, illus., Oct. 1939; also in Assoc. State Engin. Soc. Bul., vol. 14, no. 4, pp. 91-103, illus., Oct. 1939; [abstract], Iowa Univ., Studies in Engin., Bul. 19, p. 59, May 1939.
Discusses some of the most important engineering aspects of the problem of sediment transportation as they appear at the present time (1939). Lists factors which influence the quality of load brought to a stream and those which influence the ability of a stream to transport the load. Discusses briefly modes of bed and suspended sediment transportation, methods of sampling suspended load, suspended-load samplers, bed load and bed-load samplers. Properties of sediment, considered from the engineering standpoint, are particle size, specific gravity, particle slope, weight per unit volume, and resistance to wear. The progress of studies dealing with the laws of sediment transportation is briefly summarized.
 11. The need for sediment studies in Iowa streams. Iowa Engin. Soc., Proc., 1940, pp. 69-70.
Stresses the need for this information to determine the probable life of proposed reservoirs in the State and to determine the effect of the straightening of rivers to improve their flood carrying capacity upon the enlargement and deepening of the stream.
 12. Suspended-load control and the problem of channel stabilization. Iowa Univ., Studies in Engin., Bul. 20, pp. 193-201, illus., Mar. 1940.
Discusses the factors involved in the transportation of suspended matter by streams, and considers the application of the principles governing these factors to problems of channel stabilization.
 13. (and Kennedy, J. C.). A study of sedimentation in a Miami Conservancy District reservoir. Amer. Geophys. Union, Trans., vol. 21, pt. 2, pp. 607-612, illus., July 1940.
Report of an investigation made by the Iowa Institute of Hydraulic Research to determine what part of the sediment brought in by floods of the Miami River is deposited in the reservoirs of the Miami Conservancy District and to determine the character of the sediment. Data are given on variation of sediment inflow and water-level at Germantown Reservoir during the floods of Apr. 15-17 and June 18-20, 1939, concentration and size composition of inflowing and outflowing sediments, and the character of sediment deposited in the Germantown and Englewood basins. Notes that sediment deposited in Germantown Reservoir, for 10 yr. following its construction, amounted to 0.4 percent of the reservoir's capacity. States in conclusion "that unless the sediment-concentration in the inflow is unusually high, or the detention-period unusually long, sediment-deposits in retarding basins are unlikely to be a serious problem for many years."
 14. Notes on limit of sediment concentration. Jour. Sedimentary Petrology, vol. 10, no. 2, pp. 95-96, table, Aug. 1940.
Discusses the problem of the limit of concentration of suspended load in a stream; some of the concentrations reach as high as 50 percent. Notes effect of sediment load on the appearance of streams. Contains a table which gives a number of records of streams with unusually high sediment concentrations in the United States, China, and South Africa.
 15. (and Eden, E. W.). Sand waves in the lower Mississippi River. West. Soc. Engin., Jour., vol. 45, no. 6, pp. 281-291, illus., Dec. 1940.
Presents results of various observations on the movement of sand waves in the lower Mississippi River. Summarizes results of previous investigations at Bullerton, Fulton, Helena, Lake Providence and Carrollton, and more recently near the mouths of the stream. Compares observations. Results of authors' investigations at Memphis and Vicksburg are given.
 16. (and Kalinske, A. A.). Engineering calculations of suspended sediment. Amer. Geophys. Union, Trans., vol. 22, pt. 3, pp. 603-606, illus., 1941.
Presents simplified methods for making calculations of the total amount of suspended sediment in a canal or river. Use is made in the calculations of the general theory of the vertical distribution of suspended sediment in a turbulent stream of water. Checks the validity of the approximations made and indicates the accuracy of the proposed calculations by the use of field data.
 17. Need for standardization of terms used in studies of the transportation and deposition of sediment. Iowa Univ., Studies in Engin., Bul. 26, pp. 9-13, Dec. 1941.
Comments on the need of standardization of terminology in studies of sediment transportation and deposition. Discusses such terms as silt, solids, sediment, suspension, saltation, traction, bed load, detritus, geschiebe, load, and discharge. The author makes various recommendations concerning terms of use in describing the transportation and deposition of sediment.
 18. Measurement of sediment transportation. Iowa Univ., Studies in Engin., Bul. 27, pp. 83-94, illus., 1943.
Treats the measurement of the transportation of sediment in streams. Notes the movement of sediment by suspension, rolling-sliding, and saltation. Comments on the methods of measuring suspended load and bed load and notes various types of samplers. Deals with the selection of points in the stream cross section from which to take samples.

19. Sediment research needed for solution of China's flood problems. Chinese Inst. Engin. Jour., vol. 2, no. 1, pp. 105-107, May 1944.
Points out that further study is needed for the solution of sediment problems of Chinese rivers in regard to flood control; more research is necessary on sediment transportation and deposition.
20. A new method of sediment-transportation. Amer. Geophys. Union, Trans., vol. 25, pt. 6, p. 900, May 1945.
Notes a new method of transportation of solids in suspension which was observed in the Canadian River near Tulsa, Okla., and in the Root River in southeastern Minnesota. Suggests that this method of transportation be called "ripple-wake suspension."
21. Report of the Subcommittee on Sediment Terminology. Amer. Geophys. Union, Trans., vol. 28, no. 6, pp. 936-938, tables, Dec. 1947.
Deals with the terminology of sediments recommended by the Subcommittee. Defines various terms used in sedimentation. Recommends a grade scale of size terms.
Discussion: ROBERT F. LEGGET, and F. LIONEL PECKOVER, (Amer. Geophys. Union, Trans., vol. 30, no. 1, pp. 134-137, Feb. 1949), note use of the term classification. Give a chart showing comparison of principal grain-size scales. Make pertinent comments concerning the AGU and MIT scales. The writers recommend consideration be given to the adoption of the MIT scale. WALTER T. WILSON, pp. 137-138, makes various criticisms concerning definitions recommended by the Subcommittee. Criticizes the recommended table of scale of sizes. THE AUTHOR, pp. 138-139, comments on definitions. Considers various size-classification scales which have been proposed. Recommends the AGU classification to be generally adopted rather than the MIT. CARL B. BROWN, pp. 139-140, notes that one size-classification scale cannot be applicable to all the branches of science. Comments on the MIT, AGU, and USDA scales. States that the scale proposed is recommended for those working in the field of sediment transportation.
22. Sediment engineering as a quantitative science. Fed. Inter-Agency Sedimentation Conf., Denver, Proc. 1947, pp. 68-72, illus., 1948.
Describes the branch of hydraulic engineering which may be called sediment engineering and the application of sediment engineering practice. The prediction and location of deposits in reservoirs and retarding basins on streams is discussed.
Discussion: S. K. LOVE, pp. 72-73, comments on the need of reliable information about the detrital load of streams. VICTOR H. JONES, p. 73, emphasizes the fact that the relationships between the bottom set beds and density current beds are not very clear. PARKER D. TRASK, pp. 73-74, presents the value of an investigation of temperature changes from one season to the next in studying density layers. Discusses the effect of bottom configuration near the inflow of the water stream on the inclination of sediment layers in a reservoir. THOMAS MADDOCK, JR., p. 74, points out that Mr. Lane realizes that there are differences due to temperature. ALBERT S. FRY, p. 74, states that in T. V. A. reservoirs density currents are caused by temperature differences. The importance of water temperature in setting up density currents is noted.
23. Low temperature increases sediment transportation in Colorado River. Civ. Engin., vol. 19, no. 9, pp. 45-46, illus., Sept. 1949.
Presents results of observations at Taylor's Ferry sediment sampling station on the Colorado River above the Imperial Dam, 1943-47. Points out that for a given discharge, the sediment load may be as much as two and a half times as great in winter as in summer. Attempts to compute the magnitude of fluctuations of sediment load due to temperature. Studies the effect of temperature on particles of different sizes and shows that the change in load due to temperature change occurs mainly in sizes smaller than 0.3 mm. Notes that most of the effect of temperature in these observations is due to the rate of picking up material from the stream bed.
24. An estimate of the magnitude of the degradation which will result in the middle Rio Grande channel from the construction of the proposed sediment storage basins and contraction works. 46 pp., tables and graphs. Denver, Colo., U. S. Bur. Reclam., Design and Construct.
Comments on an engineering plan proposed by the U. S. Bureau of Reclamation and the U. S. Engineer Dept. which consists mainly of the construction of three large reservoirs to store water and sediment. Estimates the rate at which the lowering of the river bed downstream from the sediment storage basins will take place. Gives details of method used, effect of temperature, and need for further studies. The problem of aggradation in the channel of the Middle Rio Grande is considered.

LANEY, F. B. See Emmons, W. H., 1.

LANGBEIN, WALTER B. See also Stevens, J. C., 6.

1. Hydraulic criteria for sand-waves. Amer. Geophys. Union, Trans., vol. 23, pt. 2, pp. 615-618, Nov. 1942.

An analysis of hydraulic criteria responsible for sand waves peculiar to the Southwest. Notes that sand waves are rhythmic successions of waves which occur at flood-stages of streams with a heavy sediment load and that they are significant with sediment-transportation during floods when changes in channels take place, other influences on height of flooding being secondary. Indicates that sand waves occur only with torrential flow and are expected to be flood-adjuncts with conditions of steep slopes and fine sediments.

LANGLOIS, THOMAS H.

1. Two processes operating for the reduction in abundance or elimination of fish species from certain types of water areas. North Amer. Wildlife Conf., Trans., 6, pp. 189-201, 1941.

Deals with the factors tending to decrease the number of, or eliminate fish species from certain types of water areas. Includes discussion on land-use practices on basins of streams tributary to Lake Erie which have led to increased turbidity upon vegetation in shore bays; and the effect of silt deposition upon fish life.

LARSEN, ESPER S.

1. (and Berman, Harry). The microscopic determination of the nonopaque minerals. U. S. Geol. Survey Bul. 848, ed. 2, 266 pp., illus., tables and graphs, 1934.

Consists mainly of tables for use in the determination of the nonopaque minerals by the use of the petrographic microscope. Considers methods of determining the optical constants of minerals and the arrangement of the data in the tables.

LARSEN, HAROLD T.

1. [Review of] The passage of turbid water through Lake Mead, by N. C. Grover and C. S. Howard. Civ. Engin., vol. 7, no. 4, p. 305, Apr. 1937.
The article reviewed (Grover, N. C., 12) summarizes literature in the field of silt transportation and deposition, discusses silt underflow phenomenon and deposition of silt in reservoirs.

LARUE, E. C. See also Bryan, K., 9; Kelly, W., 1.

1. Silt in Colorado River [extract]. U. S. Geol. Survey, Water-Supply Paper 395, pp. 218-226, 1916.

Extracts from an unpublished discussion, prepared by R. B. Dole, presenting pertinent data on silt determinations in the Colorado River at Yuma, Ariz. Methods of determination and sources of suspended load are included. Gives estimates, by various observers, of silt carried past Yuma for 1892, 1900, 1903-05, and 1909-12. Data indicate lack of relationship between sediment content and discharge of stream. Average annual load carried past Yuma is estimated at 160,000,000 tons, equivalent to 125 sq. mile-ft. on the bottom of a reservoir. Influence of the Gila River on the sediment content of the Colorado is noted. Data on sediment-load de-

terminations for the Green, Grand, and Gunnison Rivers are given, indicating that the lower Colorado receives most of its load from the area tributary to the Colorado below the junction of the Green and Grand Rivers.

2. Tentative plan for the construction of a 780-foot rock-fill dam, on the Colorado River, at Lees Ferry, Arizona. Amer. Soc. Civ. Engin., Trans., vol. 86, pp. 200-217, illus., 1923.

Describes proposed construction of a 780 ft. water-tight rock-fill dam at Lees Ferry, Ariz. by blasting in canyon walls. Discusses practicability of constructing a rock-fill dam in this region and suggests plan designed to raise the water 700 ft. above the river bed. Reasons that with temporary spillway completed and flood stages passed, about 20,000,000 cu. yd. of rock could be blown into the river. The mass, weighing 40,000,000 tons, would displace sand and silt and form a watertight mud bank immediately up stream from dam. The bank, until over-topped would cut flow and would make rock-fill watertight from 50 to 100 ft. above river bed thus forming a reservoir with a storage capacity of from 100,000 to 7,000 acre-feet. Points out that with the river under control it would be necessary to place fine graded material on the upper face and center of dam. Discusses methods of utilizing large silt deposits at the mouth of Navajo Creek and in the canyon below the mouth of the San Juan River. Notes that the silt-laden waters of the Colorado would not be sufficient to tighten the dam because under the proposed plan this silt would be deposited at the head of the back-water and not at the dam, which condition favors the completed project.

Discussion: F. A. NOETZLI, pp. 221-228, points out that evidence gathered from past experience with rock-fill dams indicates certain failure of proposed plan. Observes that while the silt of the Colorado River is remarkably watertight, if precipitated from still or slowly moving water, its erosion is rapid when velocity of 3 ft. per sec. or more is attained. Maintains that such action might occur if silt membrane in the up-stream face of the proposed dam, was ruptured by abrupt settlement within the dam. KIRK BRYAN, pp. 228-240, notes geological structure of proposed site and the problem that would be raised in blasting. Points out that the Moenkopi formation and the base of the Chinli formation have a high soluble salt content which makes them ineffective fillers in small spaces in the proposed dam. Mentions that the heterogeneous landslide material on the south bank of the Colorado might be used effectively to seal dam and that there is also a large sand dune nearby which is free of soluble matter and which might also be suitable. ARTHUR P. DAVIS, pp. 240-245, presents extracts from paper on a proposed rock-fill dam on the San Juan River at Ochoa between Costa Rica and Nicaragua, which is similar to the proposed Lees Ferry dam and observes that the Nicaragua Canal Board found good reason to doubt the safety of the former project. Notes that if dam was built by the methods suggested, there would be a considerable part of the structure below the river bed founded on sand and silt. As the water rose after the dam was completed, the head on this silt would increase and no assurance could be given that a critical point might not be reached when the reservoir is full and percolation causes erosion through the silt. C. S. JARVIS, pp. 250-252, calls attention to the uncertainties that would envelop the construction and behavior of the rock-fill dam as proposed. Notes that if 20,000,000 cu. yd. of rock were thrown into the river, as outlined, erosion and transportation of finer material might continue. SAMUEL FORTIER, pp. 252-256, points out that, among other potentialities of the Colorado River, the settlement and retention of sediment within the natural channel of the river might be added. Discusses briefly results of investigations, by the U. S. Bureau of Public Roads, of silt determinations at Hanlon Station (July 1917 to June 1918) and on the Main

Canal of the Imperial Canal System at Hanlon Headgate (October 1907 to September 1908). Cost of removing silt from Imperial Valley canals amounted to approximately \$1,000,000 in 1919; damages caused by silt cost farmers \$4.42 per acre irrigated. States that storage on a large scale by concrete dams is not likely to exceed \$2.25 per acre-foot; such storage would not only provide water for irrigation, develop power, and prevent floods, but would also retain the river silt. Concludes that LaRue's proposed plan is unsuitable for the fullest development of the river's potentialities. L. F. HARZA, pp. 256-258, cites the principles which should determine the design of the blanket to tighten proposed dam. Points out that several requirements are difficult or impractical when material is deposited under water on an irregular surface, as would be the case at Lees Ferry. Notes one instance where a blast on a smaller scale was used to close a narrow gorge under a head of about 100 ft. Subsequent attempts, extending over 7 yr. to seal the rock-fill with fine material have not proved successful. Considers case of natural dam in British Columbia formed by faulting or landslides which has been silted successfully by natural processes and the silt blanket has filled the reservoir. THE AUTHOR, pp. 259-267, makes comments on points brought out by the discussers. Treats of a paper describing the Gohna Lake landslip.

3. Water power and flood control of Colorado River below Green River, Utah. U. S. Geol. Survey, Water-Supply Paper 556, 176 pp., illus., 1925. Presents detailed data regarding available water supply and proposed dam sites on the Colorado River between Cataract Canyon, Utah, and Parker, Ariz. Includes brief discussion on silt problem of the Colorado River. Average annual silt load at Yuma is estimated at 80,000 acre-feet of compacted silt as would be deposited on the bottom of a reservoir (Dole); average annual silt content at Yuma is estimated at 105,000 acre-feet or 0.62 percent by volume (U. S. Bur. Reclam.).

LASSEN, LEON.

1. Processes of adjustment in channels flowing through erodible material [abstract]. Ala. Acad. Sci. Jour., vol. 12, pt. 2, p. 53, June 1940.

A close correlation exists between elevation of the bottom of the channel of a stream and low water stages during dry periods. Plotting the elevation of the minimum state against the year gives a trend line which is taken as an index of the elevation of the bottom of a channel. A persistent upward trend shows filling the channel.

LATHROP, T. R.

1. Reforestation of Ohio water works properties. Amer. Water Works Assoc. Jour., vol. 33, no. 7, pp. 1175-1178, July 1941.

Discusses the economic aspects of reforestation of waste lands and the planting and care of forests on reservoir watersheds. Briefly summarizes the present status of reforestation on water works properties in Ohio.

LAURGAARD, O. See Anonymous, 148.

LAUSHEY, L. M. See Mavis, F. T., 5.

LAVERTY, FINLEY B.

1. Report on flood of January 21-23, 1943. 78 pp., illus., tables and graphs. [Los Angeles, Los Angeles County Flood Control District], 1943.

Presents data on rainfall, runoff, and debris movement. Comparisons with past and future storms and floods have been included.

Discussion: JOSEPH W. HALL, pp. 20-23, in a chapter entitled Debris Measurements, deals with siltation in reservoirs, erosion rates, and deposition in debris basins. WALTER J. WOOD, p. 26, in a chapter entitled Damage Caused by the Storm, summarizes the various damages caused by the storm.

LAWES, GEORGE W.

1. Subaqueous phenomena at the mouth of the Mississippi River. Assoc. Engin. Societies Jour., vol. 46, no. 4, pp. 311-314, Apr. 1911.

Discusses the phenomena of mud-lump formation, counter currents, sand waves, and sediment transportation and deposition at the mouth of the Mississippi River.

LAWFORD, C. E.

1. Silt problem in stream diversion. Veld Trust News, vol. 5, no. 5, pp. 14-15, illus., Jan. 1948.

Describes the silt problem in stream diversion in the eastern Cape Province, South Africa. Illustrates a correct design for a diversion weir in a silt-laden stream; the weir being provided with correct sluices which are properly placed.

LAWSON, ANDREW C.

1. Mississippi Delta - A study in isostasy. Geol. Soc. Amer. Bul., vol. 53, pp. 1231-1254, illus., Aug. 1, 1942.

A report which shows that a delta like the Mississippi, built out into deep water, will subside under sedimentary load. States that the delta will maintain isostatic balance throughout its growth, up to a limit of thickness which is determined by the initial depth of water. Accepts Russell's view that the alternation of degradation and aggradation of the surface of the delta is due to differences in sea level caused by glaciation and deglaciation in Pleistocene time.

LAWSON, L. M. See also Taylor, T. U., 6.

1. The Yuma project silt problem. Reclam. Rec., vol. 7, no. 8, pp. 358-359, illus., Aug. 1916.

Discusses the silt problem on Yuma project since completion of a siphon under the Colorado River. During 1912-16, the Colorado River at Yuma carried over 65,000,000 acre-feet of water containing 1,137,000 acre-feet of silt and sand, of which 600 acre-feet was deposited in the canal system. The amount of accumulated silt in the canal system is attributed to the limited area under cultivation in relation to cross sections of canals which are decreased because of the small discharge of water. Sluicing operations at Laguna Dam remove heavy sand (25 percent of total sediment) and varying quantities of silt in suspension. Increase of the area under cultivation will diminish the handling problem of silt. Notes use of dragline excavators in place of team excavation in removing silt.

2. Silt observations at Yuma Gaging Station. Reclam. Rec., vol. 8, no. 5, pp. 240-241, illus., May 1917; [abstract], Engin. and Contract., vol. 47, no. 19, pp. 437-438, illus., May 9, 1917.

Summarizes results of silt determinations made since 1909 by the U. S. Reclamation Service at the Yuma Gaging Station on the lower Colorado River. A comparison of the quantity and weight of the silt carried by the Colorado River with that of their streams is given. Includes graphs showing the relationship between discharge, velocity, silt content, and scour of channel.

3. Rio Grande Project, New Mexico-Texas. Reclam. Rec., vol. 9, no. 6, pp. 296-297, June 1918.

Report of progress on various canals of the Rio Grande Project, N. Mex. and Tex. Notes that silting up of the river channel at Hatch Canal intake necessitated construction of 1/4 mile of canal to reopen the intake. Water is delivered continuously in most canals, and is cut only to install structures and to scour silt accumulations. Devices installed for removing sand from canals have been effective.

4. Movement of silt, Elephant Butte Reservoir.

Reclam. Rec., vol. 10, no. 9, p. 411, Sept. 1919.

A news item on silt underflow at Elephant Butte Reservoir. During July 1919, water discharged from the reservoir contained 1-7 percent of silt by weight (15-day discharge estimated at 2500 acre-feet), caused by heavy rains and large inflow. The sediment remained close to the bottom throughout the entire length of the reservoir while surface water remained clear. The silt helped seal sandy canals as much as 160 miles below the dam.

5. Sand sluicing on the Rio Grande Project. Reclam. Era, vol. 16, no. 5, pp. 74-75, May 1925; also in Engin. and Contract., vol. 64, no. 2, pp. 358-360, Aug. 1925.

Discusses the silt problems of the various irrigation projects along the Rio Grande, including Elephant Butte Reservoir, Franklin Canal, Mexican Diversion Dam, Percha Diver-

sion Dam, Rincon Canal, Leasburg Dam, and Mestilla Dam. Methods of clearing canals of silt prior to the construction of the Elephant Butte Dam are discussed. The problem was the annual removal of silt from canals and laterals, it is now the prevention of deposition of sand from bed load. Bed-load movement is described. Settling basins and skimming weirs are used to prevent entry of sand to canals. Sluicing through wasteways is used to remove sand from canals. This returns the sand to the channel of the Rio Grande which is gradually filling up. A rectified Rio Grande channel will therefore be required.

6. Effect of Rio Grande storage on river erosion and deposition. Engin. News-Rec., vol. 95, no. 10, pp. 372-374, illus., Sept. 3, 1925.

On the Rio Grande River below Elephant Butte Reservoir. Notes particularly the general effect of the reservoir on river conditions. Since regulation, large destructive floods have been prevented, the total amount of sediment in the lower river has been decreased to a small percentage of that formerly carried, the elevation of the lower river channel has been raised due to lack of proper slope and decrease of flow, and there has been no great degradation of the river channel in the upper reaches of the river, such a tendency being retarded by the existence of diversion dams and canyon sections. The lower river must be confined within definite limits and on a proper gradient, so that hydraulic conditions will exist in keeping with its use as a main canal and wasteway.

7. Does desilting effect cutting power [letter to editor]. Engin. News-Rec., vol. 95, no. 24, p. 969, Dec. 10, 1925.

Discusses comments of H. Stabler (Stabler, H., 4) relative to conditions of degradation below Elephant Butte Reservoir. Notes that since completion of dam, the average annual amount of sediment in the Rio Grande at El Paso is approximately 3 percent of that formerly discharged by stream.

8. Intelligent investment and organized effort pays on the Rio Grande. Mod. Irrig., vol. 3, no. 3, pp. 12-13, illus., Mar. 1927.

Describes the Elephant Butte Dam and irrigation works on the Rio Grande above El Paso, Tex. Includes one paragraph noting that silt surveys (1916, 1920 and 1925) show 1.64 percent of silt to water, a total deposition in the reservoir of 232,000 acre-feet, and an average annual deposit of 20,000 acre-feet. Nearly three-quarters of the silt entering the reservoir is being deposited within an area containing one-quarter of the total capacity.

9. Stabilizing the Rio Grande. Sci. Amer., vol. 155, no. 8, pp. 66-68, illus., Aug. 1936.

Describes engineering works for straightening and stabilizing the meandering Rio Grande at El Paso and Juarez, in which stretch accumulations of sediment have raised the bed level, menacing improved urban and valley lands. Notes the effect of Elephant Butte Dam in scouring the channel immediately below it, the annual increment of sand, gravel, and silt entering the stream between Elephant Butte and El Paso from side arroyos; and effect of diversion works above El Paso on the deposit of sediment in the channel at El Paso and Juarez. Briefly describes proposed Cabello dam, noting provisions in storage for silt accumulations.

LAZEAR, ROBERT W.

1. Removing silt from irrigation reservoir with dragline excavator [letter to editor]. Munic. and County Engin., vol. 55, no. 3, p. 115, illus., Sept. 1918.

Describes the successful removal of silt from an auxiliary irrigation reservoir (settling basin) with a Sauerman 1/2 cu. yd. lever-type dragline outfit, at Garmesa Orchards, Fruita, Colo.

LEAGUE OF NATIONS.

1. Report by the Committee of experts on hydraulic and road questions in China. 213 pp., illus. Geneva, 1936. (League of Nations Pub. VIII. Trans. it, 1936, 4. Official No. C.91.M.34).

Reports a study on the improvement of the defense against inundation of the alluvial plain of China. Describes general development, levels, and fall of the Yellow River; character of the loess transported by the stream and distribution of loess on the stream basin; changes in the course of the Yellow River; and discharges of the river system. Discusses the influence of the Yellow River upon dike breaching and upon the alteration of hydraulic and agricultural conditions on the plain; processes by which inundations occur; types of dike breaches and methods of defense against them; various means for the improvement of the Yellow River system to diminish the violence of floods and the quantity of loess transported in order to reduce excessive deposits of solid matter; methods of dealing with floods of the Hwang Ho by means of irrigation and drainage improvements and regularization of the stream delta and estuary improvements; utilization in Shensi of the King Ho, Lo Ho, and Wei Ho for irrigation; criteria for the design of intake structures on streams carrying enormous quantities of silt; other hydraulic problems connected with irrigation works and water-power developments; reservoir silting; irrigation problems in Suiyuan and improvements; proposed hydraulic improvements to Black River, Hsiao-ching Ho, Hwai Ho, Yangtze Kiang, and other streams of North China; and Kuang Ting Reservoir on the Yung Ting Ho and its silting problem. The various aspects of sedimentation are considered throughout the report.

LEAVITT, SCOTT.

1. The national aspects of soil erosion and floods and their control by vegetative cover. *Jour. Forestry*, vol. 30, no. 3, pp. 328-335, Mar. 1932.

Address presented at the 13th Annual Convention of the Mississippi Valley Association, St. Louis, Mo., Nov. 23-24, 1931 dealing with the national aspects of soil erosion and floods and their control by vegetative cover. States that flood reduction by use of vegetal cover supplements engineering methods of control and is useful in preventing silting of reservoirs and choking of river channels with erosional debris. Notes that streams in the Great Lakes region above Minneapolis discharge annually 117,000 tons of sediment as compared with nearly 11,000,000 tons from the Tennessee River. Shoaling of streams and silting of reservoirs give evidence as to the extent of soil erosion. Cites examples of channel sedimentation of Coldwater and Tallahatchee Rivers in Mississippi.

LE BARON, J. FRANCIS. See also Corthell, E. L., 1.

1. The jetty system. *Engin. News and Amer. Contract Jour.*, vol. 10, p. 57, Feb. 3, 1883.

Reviews some successful efforts to utilize the jetty system for the maintenance of navigable channels at the mouths of streams.

LE CONTE, L. J. See Chittenden, H. M., 1; Cory, H. T., 2; Fox, S. W., 1; Hooker, E. H., 1; Ockerson, J. A., 4; Watt, D. A., 1.

LEE, CHARLES H. See Campbell, F. B., 1.

LEE, HSIN-MIN.

1. A modification of Stokes' law to account for boundary influence. Feb. 1947. Thesis (M.S.) — State University of Iowa; [abstract], Iowa Univ., *Studies in Engin.*, Bul. 33, p. 58, 1949.

Obtains a correction factor for Stokes' resistance equation in terms of the ratio of the particle diameter to the cylinder diameter from the measurement of terminal velocities of spheres falling along the axes of vertical cylindrical tubes in various liquids. An extension of Ladenburg's formula for motion with negligible inertial effects was the final result.

LEE, WILLIAM T.

1. Water resources of the Rio Grande Valley in New Mexico and their development. U. S. Geol. Survey, *Water-Supply Paper* 188, 59 pp., illus., 1907.

Presents results of investigations undertaken to aid in the development of water resources in the Rio Grande Valley, N. Mex. Outlines geography and geology of the region and considers, in connection with the topographic development of the Rio Grande Valley, conditions of erosion

and sedimentation. Notes that the Rio Grande transports 14,580 acre-feet of mud annually (Hall) indicating time required to fill reservoirs on this stream. Discusses geology of the proposed sites of the International, Engle, San Acacia, San Filipe, and Expanola Reservoirs. Amount and quality of the surface and underground water supply of the region is described. Gives suspended and dissolved load determinations of samples taken from Acequia near the Agricultural College (1893 and 1904) and from the middle of the river at Earlham Bridge (1899).

LEETE, F. A. See also Anonymous, 83.

1. (and Cheyne, G. C.). Regulation of rivers without embankments. 122 pp., illus. London, Crosby Lockwood and Son, 1924.

Deals with the training of rivers in Burma without the use of artificial embankments. The problem is one of disposal of immense quantities of sandy silt brought down by all streams from the hills. Discusses topographical features, source of the Rangoon, description of the *laha* (areas covered by floods), formation of stream channels by building up banks out of their own deposits, deposition of clay and sandy silt over the *laha*, deltaic character of the streams, effect of the backing action of the Irrawaddy upon the size of the flooded area, duration and extent of annual flooding of the *laha*, land reclamation by silt deposition, vegetation, causes of deterioration of the streams, increase in silt deposits, breaches and diversions, effect of field bunds near streams, obstruction, logging operations in Burma, channel obstructions and bank control, fixed and floating obstructions, effect of irrigation canals and sluices, bank control and straightening of channels, regulation of the Myitma, history of training works, training works without embankments, high bunds, low bunds, and no bunds. Gives conclusions relative to training works without embankment applicable to silt-bearing rivers with channels that are not large enough to carry all their normal flood water, supplementary remarks concerning courses of streams and corrective works, statistical data, and extracts from old reports on the rivers of Burma.

LEFEVRE, GEORGE

1. (and Curtis, Winterton C.). Studies on the reproduction and artificial propagation of fresh-water mussels. U. S. Bur. Fisheries, *Bul.*, vol. 30, pp. 105-202, illus., 1910.

Presents results of investigations by the U. S. Bureau of Fisheries on the possibility of artificial propagation of fresh-water mussels. Results of a study of conditions obtaining in sloughs which are closed by dams at their heads indicate that such waters are an unfavorable habitat for mussels. Describes conditions at La Crosse, Wis. Cites case of destruction of mussel beds by sedimentation near Muscatine, Iowa.

LEGGET, ROBERT F. See also Lane, E. W., 21.

1. Geology and engineering. 650 pp., illus. New York, McGraw-Hill Book Co., Inc., 1939.

A book dealing with the study of geology as applied in civil engineering. A chapter on erosion and silting includes discussions on erosion by stream flow, transportation of solid material by stream flow, silting up of reservoirs, and silting of deltas and maintenance of estuaries.

LEI, KAI.

1. A study of a method of computing sediment deposits in retarding basins. Feb. 1946. Thesis (M.S.) — State University of Iowa; [abstract], Iowa Univ., *Studies in Engin.*, Bul. 33, p. 58, 1949.

A mathematical treatment of the rate of sediment deposition in a retarding basin; based on design data of the Kuan Ting detention basin, Yung Ting Ho River, China.

LEIGHLY, JOHN B. See also Kramer, H., 2.

1. Toward a theory of the morphologic significance of turbulence in the flow of water in streams. *Calif. Univ. Pub. Geog.*, vol. 6, no. 1, pp. 1-22, illus., May 11, 1932.

Indicates a radical difference in the interaction of stream and bed as between consolidated and

unconsolidated bed material. States that assumption of downward cutting as characteristic of all streams, developing toward equilibrium, is unjustified. In unconsolidated rock, equilibriums may be obtained by widening and shallowing of stream. Any slope to be encountered in unconsolidated material may be a slope of equilibrium for a stream flowing over it, if width and depth of water in channel are properly adjusted. The cutting of an even deeper gorge, until the hydraulic slope of a stream of given discharge becomes adjusted to material carried and the walls of the gorge are perhaps reduced to gentle slopes through denudation, is a function of streams whose beds consists of material which acts as "consolidated" at those river stages which determine the form of the channel. Transverse profile and plan of the channel are determined by the nature of the reaction of bed material to turbulent flow.

2. Turbulence and the transportation of rock debris by streams. *Geog. Rev.*, vol. 24, no. 3, pp. 453-464, July 1934.

Presents a proposed new system of rational classification of modes of transport of rock debris in contrast to the traditional geomorphological system, including streams, waves, currents, wind, and glaciers. The proposed classification includes transport of rock debris through its incorporation in masses whose motion resembles lamular flow in highly viscous fluids such as gravitational mass movement and by the ice of glaciers, and transportation in suspension in turbulent currents of fluids of low velocity including stream movements within bodies of standing water and by wind. Discusses the distribution of turbulence in stream cross-sections, relation between turbulence and turbidity, and diffusion of suspended matter as a phase of transportation.

3. The boundary layer in the transport of sediment by streams. *Internatl. Geod. and Geophys. Union, Sect. for Sci. Hydrol. Bul.* 22, pp. 615-619, 1936. Deals with the velocity gradient in the boundary layer about the perimeter of a stream as an index to the ability of the stream to transport sediment.
4. Meandering arroyos of the dry southwest. *Geog. Rev.*, vol. 26, pp. 270-282, illus., 1936. Presents a discussion which deals with the sinuosity of arroyos in the arid southwest, based on the author's maps of representative sections of the arroyos. Included in the discussion are (1) primary meandering in drainage channels, and (2) the shape of meanders. An appendix dealing with the numerical characterization of the shape of bends is given.
5. Steps toward a physical theory of stream action. *Geog. Rev.*, vol. 26, pp. 331-333, Apr. 1937. Discusses briefly reports of various investigators toward the development of concepts relative to a physical theory of stream action.

LEIGHTON, M. O. See also Chittendon, H. M., 1.

1. Engineering construction by the United States Reclamation Service. *New England Water Works Assoc. Jour.*, vol. 20, no. 2, pp. 127-151, June 1906.

An address describing various irrigation engineering construction works of the U. S. Reclamation Service. Includes a brief discussion relative to the economic aspects of the reservoir silting problem, the necessity for the cleaning out of reservoirs, and the fertilizing value of silt in irrigation waters.

LENHER, VICTOR.

1. Silicic acid. *Amer. Chem. Soc. Jour.*, vol. 43, no. 3, pp. 391-396, Mar. 1921. Deals with experiments to determine relations between water and silica. Considers the effect of fine grinding of silica and its settling in water. Notes the colloidal character of silica in water, stating that if quartz is ground long enough it will go into a colloidal condition. Treats the fine grinding of orthoclase and reports that it will also go into a colloidal condition. The action of water on silica produces a silica gel and causes it to go in a colloidal form.

LENNIE, A. B.

1. Agriculture in Mesopotamia in ancient and modern times. *Scot. Geog. Mag.*, vol. 52, no. 1, pp. 33-46, illus., Jan. 1936.

Paper read at the Norwich meeting of the British Association for the Advancement of Science, September 1935, on agriculture in ancient and modern Mesopotamia. Notes that, in river control to prevent floods, protection can best be secured by the old method of opening an escape for flood waters. The difficulty is minimized in modern canals by ensuring slack water where they head off.

LEONARD, F. B.

1. (and Pickels, G. W.). Engineering and legal aspects of land drainage in Illinois. *Ill. Geol. Survey, Bul.* no. 42, 334 pp., illus., 1929.

Notes the status of drainage and gives various engineering and legal problems. Comments briefly on the silt problem and channel improvement.

LEOPOLD, ALDO.

1. A plea for recognition of artificial works in forest erosion control policy. *Jour. Forestry*, vol. 19, no. 3, pp. 257-273, Mar. 1921.

Urges the use of artificial erosion control works to supplement range control in checking erosion. Notes erosion of creek bottoms due to overgrazing and the onslaught of silt-laden floods. Describes the Blue River Valley, Ariz., noting conditions caused by overgrazing. Notes the need for planting banks, the use of wing dams or jetties, and the mapping out of flood channels to reclaim valleys. Describes gullies, their relationship to erosion, and methods of controlling them.

LEOPOLD, LUNA B. See Koelzer, V. A., 1; Stevens, J. C., 6.

LESLIE, SIR JOHN.

1. Elements of natural philosophy. Vol. 1, ed. 2, 461 pp., illus. Edinburgh, Oliver & Boyd, 1829.

Presents a comprehensive view of the principles of natural philosophy. Considers the ability of a stream to transport stones along its bed. Gives formulas dealing with the movement of stones. Notes that a stream with a velocity of 8 miles which could roll a stone of 4 ft. in diameter could only carry a pebble 3 in. in diameter with a 2-mile-per-hr. velocity.

LESTER, H. H.

1. Stream bank erosion control. *Agr. Engin.*, vol. 27, no. 9, pp. 407-410, Sept. 1946.

Considers methods of stream-bank erosion control for small streams, creeks, and branches. Deals with the problem from the standpoint of small landowners. Notes use of timber and rock jetties as mechanical means of control. Describes use of vegetative control. Considers the maintenance problem. Treats the use of structures in solving stream-bank erosion problems.

LE VASSEUR, CHARLES.

1. Bank revetment on the lower Mississippi River. *Engin. News*, vol. 46, no. 18, pp. 322-323, illus., Oct. 31, 1901.

Discusses the development of various types of bank revetment on the lower Mississippi River, 1878-99. A detailed description of each of these types is given; also the manner in which they were laid down, costs, materials, etc.

LEVIN, LEON.

1. Nouveau dispositif de dessablement des canaux (New apparatus for clearing supply channels of sand). *Génie Civil*, July 10, 1937. In French. Translation on file at the U. S. Soil Conservation Service, Washington, D. C.

Describes apparatus for the continuous removal of foreign materials from a supply channel consisting of an orifice placed in a curved portion of the supply line. Studies were carried out at the laboratory of the school for hydraulic engineers. Gives various formulas concerned with the problem. Treats wear of turbines by sediment.

LEVY, I. I.

1. Theory of silt-laden streams. *Sci. Res. Inst. Hydrotechnics, Trans.*, vol. 2, pp. 66-70, Nov. 1931. An article on theory of flow of silt-laden streams. Kennedy's formula does not satis-

factorially determine the relations between velocity of a stream, its hydraulic elements, and the quantity and size of silt it carries. On the theory that suspension of silt by water is the simple result of its turbulency, formulas are developed to show that this theory may be used as a basis for the solution of any hydraulic problem concerning streams laden with silt.

2. Hydraulic design of sluice openings. *Sci. Res. Inst. Hydrotechnics, Trans.*, vol. 15, pp. 99-145, illus., 1935. In Russian with English abstract. Translation on file at the U. S. Soil Conservation Service, Washington, D. C., and the University of Iowa, Iowa City, Iowa.

Deals with various problems relative to the design of sluice openings for intake structures of hydroelectric plants and irrigation systems constructed on streams transporting heavy bed loads.

LEWELLEN, A. B. See Farmer, H. D., 1.

LEWIS, A. D. See also Grover, N. C., 12.

1. Silt observations of the River Tigris. *Inst. Civ. Engin., Minutes of Proc.*, vol. 212, pp. 393-399, 1920-21.

Contains information on the silt content of the River Tigris as compiled from measurements made at Amara and Baghdad in 1918-19. Contains (pp. 394-395) charts showing gauge-water temperature and silt of the Tigris at Amara, and (p. 398) table showing silt passing Amara for the year 1918.

2. Silting of four large reservoirs in South Africa. *Internatl. Cong. on Large Dams (1936) vol. 5*, pp. 177-201, illus., 1938.

Pertains to the silting of Lake Arthur, Van Rynevelds Pass, Grassridge, and Lake Mentz Reservoirs, South Africa. Describes catchment areas, major features of reservoirs, hydrographic data, and conditions of erosion on watersheds. Interprets results of silt surveys, giving illustrations of longitudinal and cross sections of reservoir basins and volume relations of total silt deposited to total inflow. Offers deductions from study of results of surveys concerning reduction of silt deposits (apart from anti-erosion measures), concluding that, to pass silt beyond dams without high-velocity scouring, a study of the nature and behaviour of finer silt is necessary. Pictures boring operations into settled silt in Lake Arthur describing in detail the silt samples taken from boreholes. Discusses sampling qualities of fine silt, settlement of flocculated clay in still water in glass tubes, effect of salinity on flocculation, and shrinkage and volume-weight relations. Gives methods of reducing deposits of silt in reservoirs.

LEWIS, ALONZO.

1. (and Newhall, James R.). *History of Lynn, Essex County, Massachusetts*. 619 pp., illus. Boston, J. L. Shorey, 1865.

Includes discussion of deposits at the mouth of the Saugus River where trees, leaves and charred wood were found at a depth of 6 ft.

LEWIS, SARA I. See Churchill, E. P., Jr., 2.

LEWIS, SIDNEY F. See Beach, L. H., 1.

L'HOMMEDIEU, EZRA.

1. Communications...relative to manures. *Soc. Instituted in the State of N. Y. for the Prom. of Agr., Arts, and Mfrs., Trans.*, pt. 1, pp. 63-76, 1792.

Describes the use of fertilizers to improve land on Long Island, N. Y., which had been run down by cropping with wheat. Methods used to improve the land consisted of green seaweed taken directly from creeks and bays, drift seaweed prepared in different ways, composts of stable manure and topsoil, mud taken from creeks and swamps, leached ashes, and fish. Mud from creeks was removed in summer and exposed to frost in winter. It was spread on the soil in the spring and found to be good fertilizer, especially for grasses.

LI SHU-TIEN. See Hsu Shih-ta, 1, 2.

LIEB, VICTOR E. See Coghlan, R. R., 1.

LIEBE, HENRIETTE C. See Nicholos, J. B., 1.

LIEBERMAN, JOSEPH A.

1. Water resource and watershed management research in the southeast. *Amer. Water Works Assoc. Jour.*, vol. 39, no. 5, pp. 443-454, May 1947.

Outlines research procedures in water-resource and water-management studies being made by the U. S. Forest Service in the Coweeta Experimental Forest, N. C. Studies include determination of effects of permanent cutting, temporary cutting, cutting of stream-bank vegetation, future effects of mountain agriculture, woodland grazing, and forest fires on runoff and soil losses. Briefly outlines results obtained to date.

LIEPMANN, H. W. See Van Driest, E. R., 2.

LILLY, A. J.

1. Dredge ditches. *Iowa State Drainage Assoc., Proc.*, Feb. 11-12, 1908, pp. 9-12.

Discusses the factors to be observed in the construction of drainage ditches. Includes brief discussion on the problem of erosion and silting in open channels.

LIN, D. Y.

1. Deforestation and floods in northern China. *Jour. Forestry*, vol. 16, no. 8, pp. 888-896, Dec. 1918.

Discusses the effect of deforestation on floods on northern China. Quotes prominent engineers on the value of forests in controlling streams, silting, and floods. Discusses the effects of forests on stream flow, soil erosion, and floods. States, in conclusion, that the problem of floods can only be solved by a program of reforestation.

2. The relation of forests to destructive waters in the light of scientific investigations. *Assoc. Chinese and Amer. Engin. Jour.*, vol. 4, no. 10, pp. 1-7, illus., Dec. 1923.

An address dealing with the flood problems of China from a forestry standpoint. Comments briefly upon the influence of forests on watersheds and the conditions they create with regard to surface runoff, soil erosion, absorptive capacity of soil cover, underground seepage, and stream flow. States that the silting up of streams is mainly responsible for floods in China. Briefly considers fundamental facts with regard to the forestry aspect of flood problems in China and notes, in this connection, the relationship of velocity to the transporting power of a stream. Discusses the migratory action of the Yellow River, due mainly to the large quantities of silt carried and its subsequent deposition, resulting in higher bed levels and breaching of embankments; effect of denudation upon distribution and conservation of rainfall, regulation of stream flow, and the silt problem; and the sufficiency to control floods of engineering works such as barrages, reservoirs, dikes, and flood-water outlets. Notes necessity for cooperation between engineer and forester for the permanent solution of China's flood problem.

LINDERMAN, E. F.

1. Improving upper Mississippi River. *Engin. News*, vol. 67, no. 15, pp. 670-673, illus., Apr. 11, 1912.

Describes the improvements on upper Mississippi River by construction of wing dams which extend from shore to channel line, construction of closing dams to shut off side chutes and force water into the main channel, protection of shores against cutting at points where they form the boundary of the channel, and in detail shore revetment work. Specifications and costs for rock and brush for mattress work are given.

LINDLEY, E. S. See also Buckley, A. B., 1; Griffith, W. M., 1; Grunsky, C. E., 4, 5; Lane, E. W., 4.

1. Regime channels. *Punjab Engin. Cong., Minutes of Proc.*, vol. 7, pp. 63-74, 1919.

Reports a retest with new data of Kennedy's theory for depths, and fixes the law of variation of widths, utilizing empiric methods. Gives essential dimensions for use in designing regime channels.

2. Correct design of channels. *Punjab Pub. Works Dept., Irrig. Branch, Papers 28*, pp. 69-77, illus., Feb. 8, 1926.

Proposes and discusses a principle for the design of regime channels.

LIPPINCOTT, JOSEPH B. See also Eaton, E. C., 1; Sonderegger, A. L., 2.

1. Storage of water on Gila River, Arizona. *U. S. Geol. Survey, Water-Supply Paper 33*, pp. 1-98, illus., 1900.

- Discusses various phases of the water storage problem on the Gila River, Ariz. Includes silt observations on the Gila River. Notes that large quantities of silt are carried into the waters after cloudbursts on dry powdered land. Suspended silt by volume in the Gila River averages 2.2 percent. Tables show discharge of sediment of the Gila River at Buttes for 1895 and 1899. The average annual discharge of 9,382 acre-feet of solids is estimated to fill the proposed Buttes Reservoir in 18.6 yr. and the San Carlos Reservoir in 28.5 yr. Discusses the effect of raising the heights of dams and of the construction of additional dams at nearby sites on water capacity and supply. Describes the proposed use of a larger storm channel to maintain the water supply when the reservoir silting endangers the community, and means of cleaning silt out of the conduit. Discusses the possible development of power.
2. Irrigation possibilities of the lower Colorado River [extract]. *Forestry and Irrig.*, vol. 8, no. 4, pp. 153-159, illus., Apr. 1902.
Deals with the irrigation possibilities of the lower Colorado River. Notes possible sites for dams on the river between Needles and Yuma. A 40-ft. dam at Blue Canyon would impound 500,000 acre-feet of water and, when filled with silt, could be raised to increase capacity. The river water is always muddy; according to H. Hawgood, the Colorado carries enough silt annually to cover 100 sq. miles 6 1/2 ft. deep.
 3. Colorado River. U. S. Geol. Survey, Water-Supply Paper 93, pp. 168-172, 1904.
Describes the Colorado River and its drainage basin. Gives brief data on dissolved and suspended solids load. Notes the fertilizing value and degree of fineness of the suspended material. States that both the sediment and the dissolved salts in the river water are beneficial for irrigating purposes.
 4. Investigations in California, 1902-1903. U. S. Reclam. Serv., Ann. Rpt., 2, pp. 93-161, illus., 1904.
Presents results of investigations by the U. S. Reclamation Service (1902-03) in California. Includes a discussion on the silt problem at potential dam sites on the Colorado River. Data are given on silt carried by the Colorado River at Yuma (January 1900-January 1901); the proportion of silt, by weight, carried (February-June 1903); dry sediment, by weight, carried daily (February-May 1903); the chemical properties and fertilizing value of Colorado River silt; and dissolved solids in Colorado River waters (1902-03).
 5. Silting of the La Grange Reservoir [letter to editor]. *Engin. Rec.*, vol. 61, no. 15, p. 508, Apr. 9, 1910.
Describes measurements taken to determine the rate of silting at the La Grange Reservoir on the Tuolumne River in California. Contour surveys in 1895 and 1905 showed capacities at the 300 contour to be 2,332 acre-feet and 1,068 acre-feet respectively. Silt deposited in the reservoir in the 10-yr. period amounted to 1,264 acre-feet or 54.2 percent of the original reservoir capacity. Discharge of the river during the same period, as determined by the hydrographic branch of U. S. Geological Survey, was 18,809,707 acre-feet, the ratio of silt deposit to discharge being 0.000067. The writer finds the ratio low in comparison with other muddy streams.
- LIPSEY, T. E. L.
1. Currents at and near mouth, Southwest Pass, Mississippi River. *Prof. Mem.*, vol. 11, no. 55, pp. 65-122, illus., Jan./Feb. 1919.
Presents results of observations dealing with the currents at and near the mouth of the Southwest Pass of the Mississippi River. Includes detailed discussion on the distribution of sediment on the sea bottom beyond and adjacent to the entrance to the pass as an index to the prevailing direction of flow; the amount of sediment passing the ends of jetties; the amount of deposit directly beyond the jetty ends; and the methods of bed- and suspended-load transportation by the river. Considers the effectiveness of existing works to carry the sediment load a considerable distance seaward from the jetty ends and proposed new appurtenant works.
- LITTLE, ELBERT L. J.
1. The vegetation of the Caddo County Canyons, Oklahoma. *Ecology*, vol. 20, no. 1, pp. 1-10, illus., Jan. 1939.
Describes the vegetation of the canyons in Caddo County, Okla. Briefly describes conditions of rapid sand deposition on canyon floors by flood waters and of stream erosion resulting from deforestation, improper cultivation, and overgrazing on watersheds above the canyons.
- LITTLE, JAMES E. See Fierstein, J. H., 1.
- LITTLE, JAMES M.
1. Erosional topography and erosion [extract]. *Jour. Forestry*, vol. 38, pp. 668-669, Aug. 1940.
Applies some of the principles of hydraulics, through mathematical treatment, to the process of erosion and development of topography in relation to soil science, engineering, agronomy, and geomorphology.
- LITTLEFIELD, MAX. See also Twenhofel, W. H., 1.
1. Mississippi River gravels below the mouth of the Arkansas River [abstract]. *Geol. Soc. Amer. Bul.*, vol. 38, p. 147, Mar. 1927.
A paper presented at a meeting of the Geological Society of America, Dec. 29, 1926. Report contains results of observations on the source, quantity, and size of gravels in the Mississippi River below the mouth of the Arkansas River.
- LIU, TE-YUN. See also Mavis, F. T., 4.
1. (and Carter, Archie Newton). Transportation of the bottom load in an open channel. 34 pp., and appendix, June 1935. Unpublished thesis (M. S.) — State University of Iowa; [abstracts], *Engin. News-Rec.*, vol. 115, no. 13, p. 434, Sept. 26, 1935; *Iowa Univ., Studies in Engin.*, Bul. 19, p. 58, May 1939.
A study carried out in the laboratory of the Iowa Institute of Hydraulic Research concerning the transportation of sediment on the bed of an open channel. Objectives of the study were to find the bottom velocity at which particles of a bed are in a state of impending motion, to determine traction load, and to note the relationship between traction load and size and shape of bed material. Describes the apparatus used and the procedure. Gives computations and conclusions. Contains abstracts of selected investigations by DuBuat, Blackwell, DuBoys, Deacon, Kennedy, Gilbert, Schaffernak, Lacey, Sternberg, and Kramer.
 2. A study of bottom velocity and capacity in the transportation of bed load. 27 pp., illus., plus appendices, Feb. 1937. Unpublished thesis (Ph. D.) — State University of Iowa; [abstract], *Iowa Univ., Studies in Engin.*, Bul. 19, pp. 58-59, May 1939.
Obtains data from 400 tests in a tilting flume to compare quantitatively the relationships based on two hypotheses concerned with bed-load movement. These hypotheses state that for a given bed material, the rate of bed-load movement depends on (1) the velocity of water at the bed of the stream, or (2) the "tractive force," the latter being proportional to the product of depth of flow and slope of water surface. Determines roughness factors for Manning's formula for each test. Derives empirical formulas for rates of bed-load movement in terms of "tractive force" and bottom velocity.
- LIVSHITS, E. S.
1. Investigation of soil transportation by means of timber flumes. *Sci. Res. Inst. Hydrotechnics, Trans.*, vol. 1, pp. 163-172, 1937. In Russian. Translation on file at the U. S. Soil Conservation Service, Washington, D. C.
Field experiments to determine minimum necessary gradients in flumes for various soil mixtures and stoppage in the flumes and the character of deposition of large fractions. The experiments were conducted in an effort to find the minimum gradients required in flumes carrying pulpy soil-water mixtures.
- LOBECK, A. K.
1. *Geomorphology*. 731 pp., illus. New York, McGraw-Hill, 1939.
A textbook on geomorphology containing three chapters on stream development. Under streams in general discusses river history,

cycle of erosion, stream patterns, graded rivers, Playfair's law, genetic types of streams, and stream deflection due to earth's rotation. Discusses the characteristics of young streams, including incised meanders. In the chapter on natural streams, discusses the characteristics of natural streams, flood plains, meandering, deltas and delta characteristics, river terraces, alluvial sands, and rock pediments.

LOCKE, CHARLES E. See Richards, R. H., 3.
LOGAN, T.

1. On the Delta of the Irrawaddy. Roy. Soc. Edinb., Proc., vol. 3, pp. 471-476, table, 1857.
Describes the Delta of the Irrawaddy River in India. Considers the transporting of sediment by the Irrawaddy and the growth of the Delta. Compares the Irrawaddy with other large rivers of the world. Discusses the transporting effect of various velocities on particles of different sizes.

LOGIN, THOMAS.

1. The abrading and transporting power of water [letter to editor]. Engineering, vol. 7, p. 412, June 18, 1869.
Comments on the author's paper on the abrading and transporting power of water. Gives conclusions of observations on Ganges and Irrawaddy Rivers and Ganges Canal (India) noting that all streams in train at given velocities and depths can hold in suspension a given load of a given description; that by increasing the depth the stream will deposit a portion of its load and the decrease in depth will cause abrasion; and that retardation in flow of water is proportionate to the load held in suspension. Discusses work on the Ganges Canal noting that for artificial streams a ratio exists between slope, velocity, depth, and load of solid matter. The application to disposal of sewage in closed pipes under pressure is noted.
2. Indian roads and railways. Engineering, vol. 8, pp. 133-134, illus., Aug. 27, 1869.
Describes the effect on roads and railways in northern India of the abrading and transporting power of water. Briefly restates prominent points in the author's article Abrading and Transporting Power of Water, noting that all silt-bearing streams when in train only carry a given proportion of earthy matter depending on the velocity and nature of material transported, that an increase in velocity causes a tendency to cutting, and that the power to transport material necessitates an increased slope in the stream. Describes the plains of northern India, giving geography, strata in Gangetic and Indus valleys, and changes in bed and slope of Ganges and Jumna Rivers. A large proportion of the accidents to works is attributed to excess velocities given a stream which has been partially deprived of its silt load. Suggests remedial measures.

3. On roads and railways as affected by the abrading and transporting power of water [abstract]. Van Nostrand's Engin. Mag., vol. 1, no. 11, pp. 1015-1016, Nov. 1869.

A paper relative to the abrading and transporting power of water in connection with the economical construction of railways in upper India.

LOHR, E. W. See Collins, W. D., 6.
LOKHTINE, V.

1. The mechanism of river beds. Cassier's Mag., vol. 38, pp. 427-439, 514-531, 1910.
Deals with the subject of the nature and formation of the beds of rivers considered as a mechanical problem and taking into consideration the large forces acting to produce the result from an engineering viewpoint.

LONGRIDGE, JAMES ATKINSON.

1. The Hooghly and the Mutla. Inst. Civ. Engin., Minutes of Proc., vol. 21, pp. 2-32, illus., 1861.
Embodies results of the author's experience as to local circumstances connected with navigation of the Hooghly and the Mutla Rivers in India, around 1850-60. Contains a description (p. 9) of changes in Thornhill and other channels during the century; of results of experiments (pp. 15-17) made in 1842 on silt in suspension in the Hooghly; and (p. 27) of amount of solid matter in Hooghly, Nile, Humber and Ganges.

LONGWELL, CHESTER R. See also Agar, W. M., 1.

1. (and Knopf, Adolph, and Flint, Richard F.). A textbook of geology I. Physical geology. Ed. 2, 543 pp., illus. New York, John Wiley & Sons, Inc., 1939.

A textbook on various subjects concerned with physical geology. Contains a chapter on running water which considers gradient, shape of channel, regimen profile, erosion, deposition, transport of load, base-level, growth of deltas, etc., and a chapter on the sculpture of land by streams which discusses such subjects as stages in evolution of valleys, meanders, fluvial cycles, etc.

2. [Review of] The control of reservoir silting, by Carl B. Brown. Amer. Jour. Sci., vol. 242, no. 2, pp. 108-110, Feb. 1944.

Makes various comments on Brown's report (Brown, C. B., 21) in regard to the various aspects of reservoir sedimentation such as a comprehensive program to control silting, preventative measures, etc.

LONGWELL, J. S.

1. East Bay District experience. Amer. Water Works Assoc. Jour., vol. 41, no. 10, pp. 931-932, Oct. 1949.

Describes an erosion control program for the East Bay Municipal Utility District of California which was outlined by the U. S. Soil Conservation Service.

LORD, ROBERT C. See Jones, V. H., 11.

LORD, STANLEY R. See Lynch, H. B., 1.

LOS ANGELES BUREAU OF WATER WORKS AND SUPPLY.

1. Depth sampler. Amer. Water Works Assoc. Jour., vol. 33, no. 12, pp. 2207-2209, illus., Dec. 1941.

A short description of a water sampler designed and used by the Los Angeles Bureau of Water Works and Supply for obtaining water samples at any desired depth. Operation of the sampler is described and construction details are given.

LOS ANGELES CO., CALIF. FLOOD CONTROL DISTRICT.

1. Flood of March 2, 1938, by M. F. Burke. 52 pp., illus., tables, graphs. Los Angeles, 1938.
Presents factual data on rainfall, runoff, and debris movement relating to a flood which occurred in Los Angeles County, Calif. Makes comparisons with past and anticipated storms and floods. Includes data on siltation in reservoirs.

LOUDERBACK, GEORGE D. See Summer, F. B., 1.

LOUGEE, RICHARD J.

1. [Review of] Physiography of lower Mississippi River Delta, by Richard Joel Russell. Jour. Geomorph., vol. 1, no. 1, pp. 76-77, Feb. 1938.
Notes that the report (Russell, R. J., 1) considers problems of delta morphology. States that the topset, forest, and bottomset bedding is lacking in the Mississippi Delta. Considers the view that obstructions initiate meanders invalid. Notes that the initiation of bends is due to the presence of materials capable of easy removal at various points along the channel. Points out that the lower end of the Mississippi is youthful so the conventional criteria for old age are fallacious. States that the land bordering the Mississippi bird's-foot delta is sinking and this is evidence of geosynclinal subsidence.

LOVE, S. K. See also Collins, W. D., 9, 10; Howard, C. S., 3; Johnson, J. W., 9; Lane, E. W., 22; Potter, W. D., 1-4.

1. Suspended matter in several small streams. Amer. Geophys. Union, Trans., vol. 17, pt. 2, pp. 447-452, illus., July 1936.

Presents a paper read at a meeting of the Section of Hydrology, American Geophysical Union, Washington, D. C., Apr. 30, 1936, on the measurement of loads of suspended matter carried past 34 gaging stations on streams in 8 regional projects of the U. S. Soil Conservation Service (Kansas, Missouri, North Carolina, Oklahoma, South Carolina, Texas, Washington, and Wisconsin). Notes that the greater part of the annual load of suspended matter was carried in a relatively few days of high water. Samples were collected on rising and rapidly changing stages during floods. Graph shows distribution

- of daily loads of suspended matter. Summary of loads of suspended matter carried past each station, including maximum load per square mile for a single day and for a 15-mo. period, and corresponding discharges are given. Mechanical analyses of samples to determine distribution of sizes of particles carried in suspension are shown in graphs. Discusses the relation between discharge and load of suspended matter and includes references and graphs.
2. Soil loss in Potomac flood [letter to editor]. *Engin. News-Rec.*, vol. 118, p. 935, June 24, 1937.
Presents data on silt-load determinations made on the Potomac River during the flood of April 1937 and corresponding denudation over the drainage basin. Method of sampling, concentration of silt in samples, mechanical analysis of silt, and rates of silt movement are given. Total suspended load during Apr. 26-30 is computed at 2,210,000 tons and daily loads are given. Notes that the Colorado River at the Grand Canyon during 19 days in 1926 and 32 days in 1927 carried a daily load of more than 1,000,000 tons; by comparison, the Potomac is a fairly clear stream.
 3. (and Benedict, P. C.). Sediment loads in the Moore Creek drainage-basin, Idaho, 1939-40. *Amer. Geophys. Union, Trans.*, vol. 23, pt. 2, pp. 652-657, Nov. 1942.
Gives data on sediment loads in various streams in the Moore Creek drainage basin near Boise, Idaho. Gives data on mechanical analyses of material carried past five gaging stations near Idaho City.
Discussion: LOUIS M. GLYMPH, JR., p. 657, makes comments on the results of sampling in the area.
 4. (and Howard, C. S.). Field tests of the US D-43 sediment sampler in the Colorado River Basin, May 1944. 14 pp., tables and graphs. Washington, U. S. Geol. Survey, Water Resources Br., Quality of Water Div., 1944.
Discusses tests made with the US D-43 sampler in the Colorado River Basin during May 1944. A total of 111 samples were collected. Objectives of the field study were to observe the operation of the US D-43 sampler under high water conditions and to determine the effect of taper of the intake nozzles on the intake velocities.
 5. (and Benedict, P. C.). Discharge and sediment loads in the Boise River Drainage Basin, Idaho, 1939-40. *U. S. Geol. Survey, Water-Supply Paper* 1048, 150 pp., illus., tables and graphs, 1948.
Deals with measurements of daily discharge and sediment loads made by the U. S. Geological Survey, under a cooperative arrangement with the Flood Control Coordinating Committee of the U. S. Department of Agriculture, at 13 stations in the drainage basin during the 18-mo. period ending June 30, 1940. Data obtained furnish a basis for certain comparison of runoff and sediment loads from several areas and for several periods of time. Bed load and deposited sediment are considered. Size analyses of a large number of samples of suspended and deposited samples are presented and conclusions drawn from these analyses are given.
 6. Sedimentation program on the Geological Survey. *Fed. Inter-Agency Sedimentation Conf.*, Denver, 1947 *Proc.*, pp. 46-48, 1948.
Reviews the past history of the work in sedimentation done by the U. S. Geological Survey. The present program is also outlined and summarized.
- LOWDERMILK, WALTER C. See also Bowman, I., 2; Silcox, F. A., 2; Woodward, S. M., 1.
1. Erosion and floods in the Yellow River watershed. *Jour. Forestry*, vol. 22, pp. 11-18, Oct. 1924.
Reviews the flood problems of the Yellow River in North China based on the author's investigations relative to the effect of forests on floods. Discusses the relationship of floods to the extensive erosion of loess deposits, noting need for erosion control by vegetation in uplands together with dike construction in the plains of deposition. Conditions of the transportation and deposition of silt by streams in North China are described; the average load of silt in flood water of the Yellow River amounts to 5 percent by volume.
 2. Influence of forest litter on runoff, percolation and erosion. *Jour. Forestry*, vol. 28, pp. 474-491, illus., Apr. 1930.
Discusses experiments to determine the influence of forest litter on runoff; noting that forest litter greatly reduced runoff and erosion. Comments on normal erosion and accelerated erosion; pointing out that the index of accelerated erosion is the increased silt in runoff water.
 3. Sand rivers of China. *Soil Conserv.*, vol. 3, no. 1, pp. 1-4, 26-27, illus., July 1937.
Describes conditions of erosion and the transportation and deposition of erosional debris in the Hwai River Basin, China. Describes Hwai River watershed, type and extent of vegetative cover in the mountainous region south of the Hwai River, and the effects of progressive erosion of mountain lands on changes in flood plain deposits and on the creation of rivers of sand moving down the Hwai River and its tributaries. Discusses the source of vast quantities of sand in rivers and its effects on engineering works, navigation, and land reclamation. Effects of the culture of tea and china root on destructive accelerated erosion are described. Discusses proposed means and methods of study to solve the problems of sand movement in rivers and erosion at headwaters of the Hwai River and its tributaries, and describes plans for conservancy operations under way.
 4. Land-use and flood-flows. *Amer. Geophys. Union, Trans.*, vol. 19, pt. 1, pp. 508-516, illus., Aug. 1938.
Discusses, in connection with flood control, the accumulation of data on the absorption- and detention-capacity of land, the elusive aspects of flood-flow concentration, the importance of accelerated and induced erosion, and the effect of sedimentation in stream channels. The effect of erosional debris on downstream flood control structures is noted.
 5. Now China prepares for increased production through soil conservation. *Soil Conserv.*, vol. 8, no. 7, pp. 150-154, illus., Jan. 1943.
Contains a brief historical sketch of the development, progress, and accomplishments of the U. S. Soil Conservation Service in the United States. Gives a general description of sedimentation conditions in the Yellow River Basin, the most populous and powerful region of China, which fell into decline because of silt. Describes watershed conditions from which silt of the Yellow River was derived and their relationship to the decline of civilization. Discusses exploratory work in Syria, where more than 1,150,000 acres are ruined, much of which is buried.
- LOWE, E. N.
1. Reforestation, soil erosion and flood control in the Yazoo drainage basin. *Lumber World Rev.*, vol. 42, no. 4, pp. 47-48, Feb. 25, 1922.
Discusses the interrelation of deforestation of uplands, accelerated erosion, stream-filling, and destructive flooding of lowlands in the Yazoo drainage basin, Miss. Conditions of sedimentation on the Yazoo River and tributaries are briefly described.
- LU, A. See Hsieh, C. T., 1.
- LUCAS, B. F.
1. (and Callahan, E. P.). Major rural land use problems in Tennessee. 23 pp., illus. Nashville, Tenn., State Planning Comm., 1936.
Deals with the erosion problem as related to land use in Tennessee. Notes the effects of erosion in the upland region of west Tennessee upon conditions of stream and valley aggradation.
- LUGN, ALVIN L.
1. Methods of collecting sediment samples from the Mississippi River. *Iowa Univ., Studies in Nat. Hist.*, vol. 11, no. 8, pp. 23-31, illus., 1927.
Outlines methods and describes the apparatus employed in collecting samples of suspended and bed sediment from the Mississippi River during the summer of 1925.

2. Sedimentation in the Mississippi River between Davenport, Iowa, and Cairo, Illinois. Augustana Col. and Theological Seminary, Augustana Lib. Pubs. 11, 104 pp., illus., 1927; [abstract], Engin. News-Rec., vol. 101, no. 19, p. 691, Nov. 8, 1928. Describes results of field and laboratory studies of sedimentation in the Mississippi River between Davenport, Iowa, and Cairo, Ill., made during 1925. Gives a description of new type bottom sampler used, the method of collecting samples, and tabulated results of mechanical analyses of 235 samples. Considers the value of these determinations as sources of data on transportation and deposition of sediment by the Mississippi, and concludes that the turbulence of water is the main factor in keeping sediment suspended and in motion. Discusses the cause of turbulence and its relation to velocity; the classification of river sediment into general types, based on mechanical composition; and the diagnostic value of mechanical composition in interpreting conditions governing the formation of Mississippi River deposits.
- LUIGGI, LUIGI.
1. Irrigation works in Italy. Engineering, vol. 98, pp. 371-375, illus., Sept. 18, 1914. Describes the importance of various irrigation methods practiced in Italy. Notes the use of sluices adjacent to and at canal heads which cause a strong current across the entrance to scour away deposited matter, thereby preventing the silting up of canals. Gives the slope of canal needed to maintain the velocity at which silting and scouring will not take place. A canal is under construction near Grossetta, in central Italy, to utilize the muddy waters of the River Ombrone, which in flood carry as much as 10 percent solid matter, for silting up large marshes to a depth of 2-3 ft. and transforming them into arable land. When "colmata" is complete the canal will be slightly transformed to limit the content of silt carried. Notes the sanitary and agricultural values of silt.
- LUKENS, B. E. See White, A. M., 1.
- LUKENS, H. M.
1. Flood protection and prevention in Los Angeles County. Purdue Engin. Rev., no. 13, pp. 68-73, illus., May 1917. Deals with flood protection and prevention in Los Angeles Co., Calif., by means of storage reservoirs, river training works, and check dams. Notes that during the flood of 1914 the Los Angeles River deposited more than 4,000,000 cu. yd. of silt in the Los Angeles and Long Beach harbors.
- LUKIRSKY, P.
1. (and Kosman, M.). A method of measuring the size of particles. Soc. Chem. Indus. Jour., Trans., vol. 46, pp. 21T-25T, illus., Jan. 28, 1927. Describes a method for the study of the size distribution of particles; for this purpose a determination is made at different moments of the difference of hydrostatic pressures in two points of the falling suspension of powder. Works out a special method for the measurement of the difference of levels due to these pressures.
- LUNNON, ROBERT G.
1. Fluid resistance to moving spheres. Roy. Soc. London, Proc., Ser. A, Math. and Phys. Sci., vol. 110, pp. 302-326, illus., Feb. 1, 1926. A research undertaken for the purpose of improving the existing data on fluid resistance to moving spheres and to examine resistance in cases of accelerated motion. Treats times of fall of spheres; an analysis of the motion has given new data on the variation of resistance with speed and acceleration. Includes a critical analysis of previous results such as Sir Isaac Newton's.
 2. Fluid resistance to moving spheres. Roy. Soc. London, Proc., Ser. A, Math. and Phys. Sci., vol. 118, pp. 680-694, Apr. 2, 1928. Discusses experiments of fluid resistance to falling bodies in which spheres of steel, lead, and bronze up to 5 cm. are let fall freely in water through distances up to 200 cm. By timing the falls the resistance of a fluid at high speeds has been measured both for uniform and accelerated motion.
3. The laws of motion of particles in a fluid. Inst. Mining Engin., Trans., vol. 77, pt. 1, pp. 65-73, illus., Mar. 1929. Treats of the laws of motion of particles in a fluid and considers the effects of acceleration. Comments on Newton's law, Rittinger's law, Stokes' law, and Allen's law. Points out that Rittinger's law may be wrong to the extent of 20 percent. Presents an equation for the resistance law.
- LUTZ, J. F.
1. (and Hargrove, B. D.). Some slope and water relations affecting the movement of soil particles. Soil Sci. Soc. Amer. Proc. (1943) vol. 8, pp. 123-128, illus., 1944. An investigation to determine the effect of slope on water velocity and the effect the velocity has on the size of particles of soil carried; a shallow flow is used, giving conditions of sheet erosion. Describes the procedure and gives results of the investigation. Shows that depth is important in initial movement and in affecting the amount of material lost. Derives equations for calculating the loss of any particle size under given conditions. Presents a nomograph showing the relation between discharge, slope, and erosion.
- LYELL, SIR CHARLES.
1. On the delta and alluvial deposits of the Mississippi, and other points in the geology of North America, observed in the years 1845, 1846 [abstract]. Amer. Jour. Sci. and Arts, (ser. 2) vol. 3, no. 7, pp. 34-39, illus., May 1847. Briefly presents results of observations (1845-46) on the character of the delta and of the alluvial deposits of the Mississippi River.
 2. A second visit to North America. Ed. 3, vol. 1, 368 pp. London, J. Murray, 1855. As late as 1841, one could distinguish from the Aitamaha River, on which of its two branches a flood had occurred, since flood water from the Ocmulgee River remained clear while that of the Oconee, due to the partial clearing and cultivation of land, always carried red mud.
- LYFORD, W. H. See Prince, F. S., 1.
- LYNCH, HENRY B.
1. Transient flood peaks. Amer. Soc. Civ. Engin., Trans., vol. 106, pp. 199-218, illus., 1941; also in Amer. Soc. Civ. Engin., Proc., vol. 65, no. 9, pp. 1605-1624, illus., Nov. 1939. Describes floods of the "cloudburst" type, noting in particular the flood of Jan. 1, 1934, in Los Angeles County. Discusses drainage areas, flow sections, and hydraulic properties of burned and unburned canyons involved in the flood. Includes data on conditions creating flood surges in southern California, and on conditions of stream scour during surges. Gives velocity, and debris content of surges. Observations indicate that debris content of flood is estimated at from 50 to 70 percent solids. Describes flood damages and the destruction of check dams. Discussion: D. M. BAKER, pp. 224-227, reviews physical and meteorological conditions which produced the "flood waves" in Los Angeles County on Jan. 1, 1934. Discusses erosive and transporting power of wave fronts, and effect of denudation by fire upon the magnitude of waves. Questions value of check dams as a means of reducing magnitude of flood waves. JAMES M. FOX, pp. 227-230, stresses the effects of heavy debris content on the formation of the flood peak during New Year's, 1933-34, and on the formation of floods in southern California. Corrosion of channel was due to violent vertical currents. Presents results of investigations, 1938-39, of cloudburst floods in northern Utah and gives estimated volumes of debris deposited on fertile fans at canyon mouths. Undercutting and slumping of banks, rainfall, and runoff, are discussed. A. L. SONDEREGGER, pp. 234-239, reviews conditions surrounding cloudburst flood on Jan. 1, 1934, in Los Angeles County noting rainfall, peak flows, volume of debris removed, and check dam failure. HAROLD C. TROXELL, and STANLEY R. LORD, pp. 239-251, gives results of investigations relative to flood of Jan. 1, 1934, in southern California particularly in Pickens Canyon.

LYNCH, HENRY B. - Continued

The extent and effect of check dams, change in stream profile after flood, energetics of debris flow, debris deposition, bank erosion, mechanical composition of debris material, and flood velocities are reported. R. W. DAVENPORT, pp. 255-258, considers difficulties encountered in flood determinations, noting effect of debris content and other hydraulic factors upon the applicability of laws and formulas generally employed in discharge measurements. THE AUTHOR, pp. 264-269, comments further on data furnished by the discussers concerned with floods of the "cloudburst" type.

LYNDE, H. M.

1. Studies of maintenance work on drainage ditches. Engin. News-Rec., vol. 84, no. 15, pp. 713-715, illus., Apr. 8, 1920.

Reports studies made by the Division of Drainage Investigations, U. S. Bureau of Public Roads, 1917-20, on the maintenance of drainage ditches in Jacob Swamp in the coastal region of North Carolina. It was concluded that annual cleaning of the ditch and triennial to quinquennial cleaning of the banks was necessary. Ditches fill with both sand bars and vegetation. Outlet structures on branch ditches to prevent carrying of sand into the main waterway are of doubtful efficiency. When used, those made of logs are as effective and cheaper than those made of lumber. Sand traps must be both large and watertight. Vegetation control is discussed in detail.

LYON, T. LYTTLETON.

1. (and Fippin, Elmer O., and Buckman, Harry O.). Soils, their properties and management. 764 pp., illus. New York, Macmillan Co., 1919.

A textbook, containing a chapter on the methods of mechanical analysis of soils and another one treating the colloidal nature of soils. Discusses such subjects as the colloidal state, properties of colloids, flocculation, and soil colloids and their generation.

LYTEL, J. L.

1. Strawberry Valley project, Utah. Reclam. Rec., vol. 9, pp. 298-299, June 1918.

Reports progress at Strawberry Valley project, Utah. Notes the installation of a weir around the intake to High Line Canal and a sluicing pipe under the gates at Spanish Fork, Division Dam, for the purpose of decreasing the silt that will be carried into High Line Canal.

2. Strawberry Valley project, Utah. Reclam. Rec., vol. 9, p. 449, Sept. 1918.

Reports progress at the project. Notes that the average quantity of silt in water flowing out of Strawberry Reservoir is 0.35 of 1 percent.

MCALPINE, WILLIAM J.

1. Improvement of the mouth of the Mississippi River. Amer. Soc. Civ. Engin., vol. 4, no. 114, pp. 332-333, 1875.

Discusses early jetty methods of preventing deposition and removing bars at the mouths of rivers (Mississippi River) in contrast to existing method of levees. Notes effect of reduced velocity, winds and littoral currents on bar formation.

MCBAIN, JAMES W.

1. The determination of sedimentation rate and equilibrium in centrifuges and ultracentrifuges. Science n. s., vol. 87, no. 2248, pp. 93-94, Jan. 28, 1938.

Discusses the use of centrifuges and ultracentrifuges for quantitative measurements of particle size or molecular weight for every kind of solution or suspension. Particles or molecules of different sizes are measured and detected by varying rates of sedimentation in successive experiments.

MCBETH, WILLIAM A.

1. Notes on the Delta of the Mississippi River. Ind. Acad. Sci. Proc., 1904, pp. 47-49, illus., 1905.

A paper briefly dealing with the hydraulic factors connected with the growth of the Delta of the Mississippi River.

MCCABE, W. L. See Egolf, C. B., 1.

MCCAFFREY, A. H.

1. Flood control for Johnstown. Pub. Works, vol. 78, no. 12, pp. 27-28, illus., Dec. 1947.

A comprehensive plan to eliminate flood conditions in a Mohawk Valley city. Comments on creek straightening and lining. Describes Schriener's Pond, created by damming up Hale and Comrie Creeks, N. Y., which drain into Cayadutta Creek. Silt for the past 50 yr. settled in the pond, except for channel through center, filling in pond so that storm water tops dam and floods area half a mile upstream, including some streets. Damage estimated \$8000 for each major overflow. Twenty-seven-foot section of dam was removed. Six hundred feet of new channel was constructed. The alignment of stream bed was changed. Plan calls for eliminating 600 ft. of 2500-ft. stretch of creek to increase the flow capacity.

MCCALLIE, S. W.

1. Deforestation and erosion. Amer. Forestry, vol. 28, no. 343, pp. 394-396, illus., July 1922; [extract], Lit. Digest, vol. 74, pp. 23-24, illus., Aug. 26, 1922.

An account of deforestation and erosion in southeastern United States. Notes that the Savannah River annually carries to the sea more than 2,500,000 tons of suspended matter. Terracing, deep plowing, and forestation are the only practical means of controlling soil erosion.

MACCLINTOCK, PAUL.

1. [Review of] Some principles of accelerated stream and valley sedimentation, by Stafford C. Happ, Gordon Rittenhouse, and G. C. Dobson. Jour. Geomorph., vol. 4, pp. 150-151, Apr. 1941.

Reviews the publication (Happ, S. C., 9) and mentions various points concerning stream and valley sedimentation.

M'CLURE, DAVID.

1. Changes in the River Delaware. Hazard's Register Pa., vol. 1, no. 17, pp. [257]-260, Apr. 26, 1828. Information on a survey of the Delaware River, from one mile below Chester to Richmond, that was made by David M'Clure in 1820. Reports changes occurring during the 15 yr. prior to the survey. Changes consisted of washing away of islands and shore lines and the shoaling of channels. Cites many specific cases.

MCCLURE, JOHN.

1. Bombay Harbor survey and tidal model. Inst. Civ. Engin., Minutes of Proc., vol. 232, pp. 66-79, illus., 1931.

A general survey of Bombay Harbor, India, reporting observations on the uses of the tidal model. Observations on siltation of the harbor, (special observations,) records, and historical notes are included.

MCCLURE, W. F. See Gault, H. J., 1.

MCCORMACK, J. T.

1. Rate of sedimentation in Boomer Lake [abstract]. Okla. Acad. Sci., Proc., vol. 10, p. 105, 1930.

Studies to determine rate of sedimentation of Boomer Lake, Stillwater, Okla. Studies include determination of amount of wind-borne material entering lake, amount of sediment carried by streams entering lake, and amount and nature of suspended matter in lake water. Silting over entire area of reservoir is about 9 in. per year, indicating an effective life of 25 yr.

MCCRAE, J.

1. Suspended solids in the water of uppermost reach of the Vaal River. Water and Water Engin., vol. 49, no. 598, pp. 9-13, Jan. 1946.

Gives suspended-load data for the uppermost reach of the Vaal River, which rises in the southeast of the Transvaal. Includes data on the effect of the Vaal Dam on silt carried and its rate of silting. Notes that the average annual deposition is 0.0027 or about a quarter of 1 percent of the capacity of the dam.

MCCRORY, S. H. See Morgan, A. E., 1.

MCDANIEL, BRUCE.

1. Dredging rivers by stream flow. Tech. World Mag., vol. 23, no. 5, pp. 677-678, illus., July 1915.

Describes details of construction of a dredge which utilizes the motive force of a stream to remove sand and gravel obstructions from channels. Results of an experimental demonstration are given.

MACDONALD, MURDOCK. See Buckley, A. B., 1.

MACDOUGALL, C. H.

1. Bed-sediment transportation in open channels. Amer. Geophys. Union, Trans., vol. 14, pp. 491-495, illus., June 1933.
Discusses experiments by G. K. Gilbert and others on laws governing sediment transportation. Describes experimental apparatus constructed by author in the River Hydraulic Laboratory of the Massachusetts Institute of Technology, to examine laws of sediment transportation. Summarized results of author's studies, including formulae and graphs.
2. An experimental investigation of bed sediment transportation. Massachusetts Institute of Technology, River Hydraulic Laboratory, 1934.
Deals with research to determine the relation between the hydraulic factors in a flume and bed load, carried on in the River Hydraulic Laboratory of the Massachusetts Institute of Technology. The author hopes the results will aid in the solution of the problem of the transportation of sediment in natural streams. Synthetic sand mixtures were used. Gives a brief historical resume of research in sediment transportation. Reports methods of procedure, and describes the apparatus used. Considers bed-load movement, mathematical analysis, existing equations for sediment movement, and the development of a rational formula. Results of investigations are reported.

MCDOWALL, G. W.

1. The erosion of Sioux Point, South Dakota. Monthly Weather Rev., vol. 39, p. 877, June 1911.
Describes conditions of bank erosion and proposed means of bank protection on the Missouri River at Sioux Point, S. Dak.

MACEY, H. H.

1. Clay-water relationships. [London] Phys. Soc., Proc., vol. 52, pt. 5, no. 293, pp. 625-656, illus., Sept. 1, 1940.
Shows the relationship which exists when a plastic mixture of clay and water is subjected to a steady pressure between porous pistons. Considers experimental and calculated moisture-content distribution in clay bars drying from one end only.

MC GEE, W. J.

1. The Pleistocene history of northeastern Iowa. U. S. Geol. Survey, Ann. Rpt. (1890) 11, pt. 1, pp. 189-577, illus., 1891.
Discusses river terraces in some detail; divides them into four classes; and gives theories of their formation. Comments on planes of variegation and sediment transportation. Treats the law of river gradation. Notes that Hopkins in 1844 demonstrated that the moving force of a stream varies as the sixth power of the velocity, while corrosion varies roughly as the square of the same element. Gives the law of fluid variegation.
2. Sheetflood erosion. Geol. Soc. Amer. Bul., vol. 8, pp. 87-112, illus., Feb. 13, 1897.
Describes conditions of sheetflood erosion in the Sonoran district of southwestern Arizona. Includes a description of conditions of stream erosion in the district.
3. River sediment as a factor in applied geology [abstract]. Science n. s., vol. 26, no. 646, p. 265, May 17, 1907.
Abstract of paper by W. J. McGee stressing the importance of the sediment load of a stream as a factor to be considered in connection with the construction of engineering works for stream control.
4. Saving the soil. Forestry and Irrig., vol. 14, no. 2, pp. 77-78, Feb. 1908.
General information relative to the amount of sediment carried to the ocean annually from the United States, and its value as a fertilizer.
5. Outlines of hydrology. Geol. Soc. Amer. Bul., vol. 19, pp. 193-220, Sept. 4, 1908.
Discusses the elements of hydrology and applications of hydrology. Treats of the special functions of moving water such as erosion, transportation, and deposition. Notes the work of Gilbert on the capacity of streams for loads of given size particles. States that the internal work of streams varies widely with external factors. Discusses the term competence of

running water in denoting the ability of water of varying velocity to move particles of given size.

MC GEORGE, W. T.

1. Influence of Colorado River silt on some properties of Yuma Mesa sandy soil. Ariz. Agr. Expt. Sta., Tech. Bul. 91, pp. 199-217, illus., June 1, 1941.
Presents data showing that both structurally and texturally the Superstition sands of the Yuma Mesa can be improved by incorporating Colorado silt. Considers the effects of incorporation of river silt upon the settling volume, apparent specific gravity, pore space, and water-holding capacity of Superstition sand; upon the percolation rate and rate of capillary water movement; and upon the fertility of the sandy land because of the potash, phosphate, and nitrogen present in the silt.

MC GLASHAN, H. D.

1. (and Ebert, F. C.). Southern California floods of January 1916. U. S. Geol. Survey, Water Supply Paper 426, 80 pp., illus., 1918.
Presents available data on the effects of floods of January 1916, in southern California, noting precipitation, runoff, and flood damages. Reports extent of damages in San Diego, Orange, Riverside, San Bernardino, and Los Angeles Counties, due to stream erosion, to the deposition of silt and erosional debris.

MCGREW, P. C. See Rockie, W. A., 2.

MCHUGH, F. D.

1. Stream sedimentation studies provide valuable data. Sci. Amer., vol. 158, p. 354, illus., June 1938.
Notes the completion of an hydraulic laboratory constructed by the Works Project Administration of North Carolina across Rocky Creek, Iredell County, for purposes of sedimentation studies.

M'INALLY, T. W. See Miller, W., 1.

MACINTYRE, R. W.

1. River control by wing dams [abstract]. Engin. and Contract., vol. 55, no. 7, pp. 162-163, Feb. 16, 1921.
Abstract of a discussion of a paper (Curd, W. C., 1) submitted to the American Society of Civil Engineers describing river control by wing dams of Capilano River, British Columbia. Describes conditions necessitating control measures, details of log wing dams and bank revetment, and action of wing dams. Gives essential points in the use of wing dams.

MCKEE, EDWIN D.

1. Original structures in Colorado River—flood deposits of Grand Canyon. Jour. Sedimentary Petrol., vol. 8, no. 3, pp. 77-83, illus., Dec. 1938.
Describes types of bedding and cross-lamination in structures developed during deposition of flood deposits along the Colorado River in Grand Canyon. Discusses briefly the character of the flood deposits.
2. Some types of bedding in the Colorado River Delta. Jour. Geol., vol. 47, no. 1, pp. 64-81, illus., Jan./Feb. 1939.
Describes the principal types of lamination on the Colorado River Delta and discusses two types of pseudobedding. Conditions of deposition and character of sediments deposited in the Delta during recent years are considered.

MCKELVEY, V. E. See Hellman, N. N., 1.

MACKIE, WILLIAM.

1. On the laws that govern the rounding of particles of sand. Edinb. Geol. Soc., Trans., vol. 7, pt. 3, pp. 298-311, illus., 1897.
Deals with the microscopic examination of sands in order to determine laws that govern the rounding of sand grains. Notes that the rounding of sand grains is affected by the following five factors: the size of particles; specific gravity; hardness; distance traveled; and transporting agent. Presents a formula for deriving the coefficient of "roundability" or "psephicity" for minerals. Includes a table of relative "psephicities" or facility of being made into pebbles, for 16 minerals; also considers various exceptions.
2. The sands and sandstones of Eastern Moray. Edinb. Geol. Soc., Trans., vol. 7, pt. 3, pp. 148-172, 1897.

Discusses the use of various mineralogical and physical features of sands in order to trace them back to sources from which they were derived. Discusses the origin and process of derivation of sands, and by implication the origin of sandstones of Eastern Moray. Various sands are examined under the microscope and interpretations given for various features. Considers methods of tracing sand grains back to rocks from which they are derived. Notes the elimination of feldspar as a constituent of sand as determined by observations of sands from various rivers in Scotland. Divides quartz grains into classes as determined by inclusion and the value of tracing sand grains to source rocks by the use of inclusions.

3. The principles that regulate the distribution of particles of heavy minerals in sedimentary rocks, as illustrated by the sandstones of north-east Scotland. Edinb. Geol. Soc., Trans., vol. 11, pp. 138-164, 1925.

Discusses the principles which regulate the presence or absence of heavy minerals in a sediment. Comments on the concentration of heavy minerals in river channels, the lighter materials being separated from heavier due to the selective action of running water. Notes concentrations of heavy minerals within the area of deposit. Considers changes in minerals leading to their disappearance in transit. Points out that heavy minerals show a tendency to occur in abundance in peripheral positions in areas of deposit.

MACKIN, J. HOOVER.

1. The capture of the Greybull River. Amer. Jour. Sci., vol. 31, no. 185, pp. 373-385, illus., May 1936.

Gives a description and an explanation of stream capture of the Greybull River, Wyo. A small stream rising in the arid central part of Big Horn basin effected the capture of the much larger Greybull River, which enters the basin from the encircling ranges, because the graded gradient of the small stream, adjusted to the transportation of fine silts and sands derived from weak shales which floor the basin, was lower than the graded gradient of Greybull River, which is adjusted to the transportation of coarse rock waste from the mountains. Includes a map of Greybull River area and photographs of Greybull River and Dry Creek at the extreme low-water stage showing the contrast between coarse gravel transported by the Greybull and fine silt carried by the Dry Creek.

2. Concept of the graded river. Geol. Soc. Amer. Bul., vol. 59, no. 5, pp. 463-512, May 1948.

Modifies and extends the theory of grade originally set forth by Gilbert and Davis. Comments on the definition of grade and a graded stream. Discusses the profile of a graded stream and factors controlling slope of graded profile. Reviews the principles of stream transportation from the works of Gilbert, Rubey, and Hjulsström. The response of the graded streams to changes in control are described. Aggradation is commented on. Points out the analogy between a stream's response to work of man and to accidents and interruptions due to geologic causes. The need of closer cooperation of workers concerned with streams is noted.

MCLAUGHLIN, THAD G.

1. Accelerated channel erosion in the Cimarron Valley in southwestern Kansas. Jour. Geol., vol. 55, no. 2, pp. 76-93, illus., Mar. 1947.

Describes accelerated channel erosion in the Cimarron River from the Kansas-Colorado State line to the Kansas-Oklahoma State line. The average width has increased from a narrow channel to over 1000 ft. since accelerated erosion began in 1914. The principal cause of erosion appears to have been over-cultivation. Includes early descriptions and recent testimony.

MCLAUGHLIN, W. W.

1. Methods used in sampling river water for the determination of silt content. Hydraulic Engin., vol. 4, no. 5, pp. 260, 291-292, illus., May 1928.

Discusses methods and equipment used in sampling river water for the determination of silt content by the U. S. Bureau of Public Roads (Tech. Bul. 67). Topock, Yuma, Tait-Binckley and canal-bottom samplers are described. Notes that Colorado River in a single year carried 200,000,000 tons of suspended silt past Topock, an estimate of 250,000,000 tons of silt normally transported to lower end of the river's canyon section. Reports the necessity of impounding water in reservoir to a depth of over 500 ft. by the dam in Boulder or in Black Canyon so that capacity may not be reduced by deposition of silt more than 2/3 in 100 yr. of operation.

2. Significant studies in hydrology on the Pacific Coast. Amer. Geophys. Union, Trans., vol. 12, pp. 202-205, June 1931.

Summarizes the work conducted by the Division of Agricultural Engineering in the West. Includes one paragraph noting studies relative to the laws governing the transportation and deposition of sediment with a view toward developing a means of ridding canals of bed load.

MCLAURIN, BANKS. See Taylor, T. U., 6.

MCLOUD, NORMAN G.

1. Holding the banks of the Mississippi. Amer. Forestry, vol. 29, no. 352, pp. 242-243, 249, illus., Apr. 1923.

Describes the successful use of woven mattresses to protect banks of the Mississippi against erosion. In the 750 miles between Cairo and the mouth of the Red River the average annual cutting of Mississippi River banks totals 1,000,000,000 cu. yd. This material is deposited below bends and causes constant shifting of channel. Willow mats provide durable and efficient bank protection.

MCMATH, ROBERT E. See also Cortell, E. L., 1.

1. The Mississippi as a silt bearer. Van Nostrand's Engin. Mag., vol. 20, no. 123, pp. 218-234, Mar. 1879.

Presents the hydraulic characteristics of the Mississippi River with special reference to the stream as a silt bearer. Outlines a suggested method for an investigation of silt movement in the Mississippi River to guide conduct in connection with the construction of works to improve navigation, restrict floods, and fix the bed of the river.

2. Theory and application of the permeable system of works for the improvement of silt bearing rivers. Engin. News, vol. 6, pp. 353-355, Nov. 1, 1879.

Discusses the theory and practical application of the following: (1) large quantities of sedimentary matter are carried by currents of Mississippi River, (2) transport of this matter is not continuous from place of origin to that of deposit, the sea, and (3) moving material may be arrested and controlled in accordance with location and form of deposit by artificial means of improvement to a silt-bearing river like the Mississippi. Proposes a system of works based on a broad claim that it is the only method of improving the Mississippi since it includes the adaptation and extension of well-tried principles to particular conditions found on the Mississippi River.

3. Silt movement by the Mississippi—its volume, cause and conditions. Assoc. Engin. Societies Jour., vol. 1, pp. 266-275, illus., Nov. 1881.

Gives data on suspended load carried by the river. Suggests hypotheses concerned with silt transportation and the force used.

4. Silt movement by the Mississippi—its volume cause and conditions. Van Nostrand's Engin. Mag., vol. 28, no. 1, pp. 32-39, illus., Jan. 1883; also in Assoc. Engin. Societies Jour., vol. 1, pp. 266-275, 1882.

Reports observations and gives conclusions of study on volume, and the cause and conditions of silt movement by the Mississippi River. Locality and methods of sampling described. Notes that during Mar. 31 to June 25, 1879 (87 days), 62,363,009 cu. yd. of suspended matter passed observation point (foot of Grand Ave., St. Louis). Gives C. R. Suter's observations on volume of solid matter borne by the

- Missouri River, near St. Charles. Observations by Mississippi River Commission for period Jan. 1 to Oct. 8, 1880, at Fulton, Tenn., reported that 217,728,125 cu. yd. of suspended matter passed that station. Describes results of Col. Flad's experiments on rate of settling of minute particles. Discusses hypotheses on the forces required to carry matter in suspension, noting that the power of erosion and suspension is due to irregular movements, which arise in all bodies of moving water, and are in complex proportion to velocity of stream, and character and condition of bed and banks. Considers variations in ability of the river to carry its burden due to relative values of sectional area which depend upon width and form of section. States that scour and deposits in Mississippi River are local and alternate at a given locality as the river passes from one extreme of stage or volume to other. Gives observations to support conclusions.
5. Levee theory tested by facts. Amer. Soc. Civ. Engin., Trans., vol. 13, pp. 331-358, illus., 1884. Discusses the interdependence between obstructions, both artificial and natural, and the regime of the Mississippi, with reference to scouring and silting. Presents observations on the influence of overflow on velocity variations in various Mississippi River districts. Writer criticizes findings of Mississippi River Commission relative to theory upon which levee construction was based, giving formulas, graphs, and tables supported on local observations for discharges, velocities, gauges, and areas. Discusses scouring and filling in the light of these data.
Discussion: J. A. OCKERSON, (Amer. Soc. Civ. Engin. Trans., vol. 14, pp. 219-226, illus., May 1885), considers theory of levee location from point of view of possibility of erosion in a given pass of the Mississippi River at various stages. States belief that hydrographic maps show that not only changes in depth, but also other causes effect channel conditions, especially in immediate vicinity of new crevasses. Discusses the influence of scouring and backwater on silt deposits just above a new outlet. Notes in general necessity of levee construction to scour at point where needed. Discusses danger of carrying entire volume of water into Gulf through a single pass. Observes the need for scouring of channel banks and bed.
 6. Velocity and sediment [letter to editor]. Science, vol. 6, no. 126, pp. 2-3, July 3, 1885. Comments on an article relative to observations on velocity and sediment in the lower Mississippi River (Harrod, B. M., 1). States that stream erosion and silt transportation are due to various dynamic conditions which may be local.
 7. Report on the St. Louis water supply by an expert commission [abstract]. Engin. News, vol. 47, no. 10, pp. 196-199, Mar. 6, 1902. Reports a study of the best method to supply St. Louis with water. Gives observations of suspended solids in the Mississippi River at Bissell's Point (1885-88) and at Chin of Rocks (1900-01). Evidence shows that the Mississippi River at St. Louis carries not less than 1,500 parts of sediment per 1,000,000 parts for normal year. Compares percentages of sediment in the Mississippi River at St. Louis with those in Merrimac River at Lawrence, Hudson River at Albany, Alleghany River at Pittsburgh, Potomac River at Washington, D. C., Ohio River at Cincinnati, and Louisville and Mississippi Rivers at New Orleans and the St. Louis intake. Discusses efficiency and time of subsidence (sedimentation) of Mississippi River sediment, sedimentation after addition of coagulant, and capacity of filters. The suitability of the Mississippi and Merrimac Rivers as source of supply was recommended in majority report by Messrs Williams and Wisner. Minority report by Mr. Hazen supplemented by letter of G. W. Fuller advocated continued use of Mississippi River water, and with preliminary treatment to reduce turbidity.

MCMLLEN, J. H.

1. (and Stutzman, L. F., and Hedrick, J. E.). A pendulum method for measuring settling velocities. Indus. and Engin. Chem., Analyt. Ed., vol. 13, no. 7, pp. 475-478, illus., July 1941.

Describes a method developed to determine the settling in opaque suspensions in which the stability of a suspension and the rate of particle fall can be determined by a few simple measurements. The principles of the compound pendulum and an extension of a method introduced by Manning and Taylor (Inst. Chem. Engin. [London], Trans., vol. 14, p. 45, 1936) are utilized in this method.

MCNOWN, JOHN S. See Dobbins, W. E., 1; Einstein, H. A., 4.

MCPHERSON, MURRAY B.

1. Boundary influence on the fall velocity of spheres at Reynolds numbers beyond the Stokes range. Aug. 1947. Thesis (M. S.) — State University of Iowa; [abstract], Iowa Univ., Studies in Engin., Bul. 33, p. 58, 1949.

Develops equipment and experimental techniques which allow the extension of the work of Lee (Lee, H. M., 1) to spheres having a maximum Reynolds number of 200 and sphere-to-cylinder diameter ratios from zero to 1/16. The accuracy of measurement was increased by the thermostatic control of fluid temperature and stroboscopically lighted photographs. Points out that the empirical drag function currently in general use was, because of boundary influences neglected in earlier studies, as much as 10 percent too high. Notes that the effect of the diameter ratio in altering the coefficient of drag decreased as the Reynolds number increased from 0.1 to 10.

MADAN, MOHAN LAL.

1. Sampler vs. sampler (suspended silt) [abstract]. India Cent. Bd. Irrig. Pub. 29, p. 113, 1943. Compares the Puri, Binkley, and Uppal suspended silt samplers with the bottle sampler adopted as a standard in the Punjab by carrying out a number of observations in the Upper Bari Doab Canal.
2. Verification of Lacey's modified basic equation $W_s = K \sqrt{Q}$. India Cent. Bd. Irrig. Pub. 29, pp. 76-78, illus., 1943. Comments on the modification of Lacey's basic equation. Logarithmic correlation was worked out between W_s and Q for 42 regularly observed Punjab channels. Variations of $W_s \sqrt{Q}$ was compared with P/\sqrt{Q} . In regard to the Punjab channels, Lacey's basic equation was found to fit the data better than his modified equation.
3. Mean velocity and mean silt points. India Cent. Bd. Irrig. Pub. 31, pp. 85-87, 1944. Discusses investigations to determine a point on the central vertical of the cross section of a channel where the suspended silt content is such that its product with the discharge will give the total floating silt charge of the channel, and to see how the point varies from day to day and from channel to channel.

MADDOCK, THOMAS, JR. See also Lane, E. W., 22.

1. Reservoir problems with respect to sedimentation. Fed. Inter-Agency Sedimentation Conf., Denver, 1947, Proc., pp. 9-14, 1948. Describes various types of reservoirs and gives causes for loss of their storage capacity in the Western States. Discusses various reservoir problems such as effect of evaporation, transpiration, etc. The location of sediment deposits in western reservoirs is considered. Notes use of methods of reservoir operation in reducing rate of sedimentation.
Discussion: GUNNAR M. BRUNE, pp. 14-16, describes problems encountered in study of four reservoirs in Ohio. Shows effect of World War II on rates of reservoir sedimentation and effect of intertilled crops. VITO A. VANONI, p. 17, comments on use of density currents in reservoir sedimentation.
2. A symposium - watershed management in relationship to water runoff and siltation - retarding and impounding structures aid control of runoff and siltation. Jour. Soil and Water Conserv., vol. 3, no. 1, pp. 34-36, Jan. 1948.

MADDOCK, THOMAS, JR. - Continued

Discusses the use of retarding and impounding structures as aids in the control of runoff and siltation. Comments on the importance of design and maintenance of structures.

MADSEN, M. J.

1. A preliminary investigation into the results of stream improvement in the intermountain forest region. North Amer. Wildlife Conf., Trans. 3, pp. 497-503, 1938.

Presents results of observations on the effects of stream improvements upon wildlife conditions in streams of the Intermountain Region of Idaho, Nevada, Utah, and Wyoming. The effects of log dams upon conditions of silting above and scouring and deposition below the dams are considered.

MAGER, F. W.

1. The employment of storage reservoirs in irrigation with special reference to the Krian irrigation undertaking [abstract]. Indian Engin., vol. 76, p. 259, Nov. 8, 1924.

Describes the largest irrigation work in British Malaya, conditions of silting in the Krian Reservoir, and measures taken to check the deterioration of the reservoir.

MAIGNEN, J. P. A.

1. Irrigation. Amer. Soc. Civ. Engin., Trans., vol. 62, pp. 15-19, 1909.

Discusses various problems relative to irrigation. Notes desirability of provision for small works at all entrances to irrigation canals to divide the mud and heavy grit carried in the water and to permit the former to be carried in canal to close up leaks and to fertilize the soil. States that algae does not grow in water full of suspended clay, it being presumed that suspended matter excludes light.

MAITS, C. B., JR.

1. She lived by the side of an old-time mill. Soil. Conserv., vol. 2, no. 4, pp. 66-71, Oct. 1936.

Describes the silt deposit behind Kings Dam on the west branch of the Octoraro Creek near Kings Bridge, Lancaster County, Pa. Washout of old Kings Dam showed deposit of silt 11 ft. deep behind dam. Calculations by the U. S. Soil Conservation Service showed that 27,000 tons of rich topsoil was backed up by the dam. Describes the continuous silting behind dam after repeated breaks have been repaired and notes the extent of soil erosion involved.

MAJEED, M. A. See Dryden, L., 3.

MAJUMDAR, S. C.

1. River problems in Bengal. Indian Engin., vol. 105, no. 6, pp. 204-212, June 1939.

An article relative to silt as a dominating factor in river problems in Bengal. Discusses the building up and the gradual raising of the Indo-Gangetic Plain, by silt deposited by rivers, by delta formation at the mouth of Ganges, and by the influence of upland flood carriers and tides on delta building. Classifies rivers into three types according to their special characteristics of erosion, and quality and tectonic activity of silt. Describes general regime of large rivers. Notes beneficial and malevolent aspects of silting and outlines proposed solution of problem. Government conference held July 1938, arrived at decisions relating to flood embankments, irrigation, water resources, river training, erosion and silt control. Describes recommended surveys.

MALAIKA, JAMIL.

1. Effect of shape of particles on their settling velocity. Feb. 1949. Thesis (Ph. D.) - State University of Iowa; [abstract], Iowa Univ., Studies in Engin., Bul. 33, pp. 59-60, 1949.

Deals with an experimental and theoretical investigation on the effect of particle shape on settling velocity. Uses representative axisymmetric shapes within a Reynolds-number range from 10^{-4} to 10^{-3} . Determines theoretically the resistance of spheroidal particles moving within Stokes' range. Concludes that all shapes followed a resistance law in the viscous zone parallel to Stokes' law for the sphere. Develops a semi-empirical equation, combining three particle shape characteristic factors, for de-

termining settling velocity. Notes that particles having similar positions and ratios of their principle axes regardless of shape had a comparable dynamic behavior, and therefore the theoretical results have application for a variety of shapes.

MALHOTRA, JAI KRISHAN. See also Bose, N. K., 2.

1. Formula for the rate of silting of the Elephant Butte Reservoir. India Cent. Bd. Irrig. Jour., vol. 5, no. 1, pp. 51-64, illus., 1948.

States that the rate of silting of the Elephant Butte Reservoir has gradually declined during the period from 1915 to 1940. The writer re-analyzed the data on Elephant Butte Reservoir which were given by Stevens in a report entitled Future of Lake Mead and Elephant Butte Reservoirs, (Amer. Soc. Civ. Engin., Proc., vol. 71, no. 5, May 1945). The "cumulative" deposit was plotted against "cumulative years" and an equation developed for this curve. By differentiating this equation the rate of silting was obtained.

MALHOTRA, S. L.

1. Remodelling of channels on the Lower Bari Doab Canal, illustrated by Dulwan (15L.) Distributary. Punjab Engin. Cong., Minutes of Proc., vol. 22, pp. 17-49, illus., 1934.

Describes methods of remodelling channels on the Lower Bari Doab Canal, as illustrated by the Dulwan (15L.) Distributary. Includes description of use of hanging spurs to scour out bed and to constrict channel by inducing side berm deposits. Considers the silting of canal beds as a cause of change in regime of canals. Lists methods employed to remedy the silting problem.

MALOTT, CLYDE A.

1. Some special physiographic features of the Knobstone Cuesta region of southern Indiana: An example of explanatory physiography. Ind. Acad. Sci., Proc., pp. 361-383, illus., 1919.

Deals with the physiographic features of the Knobstone Cuesta region, southern Indiana. Included in the discussion are details of the successive piracy of the Muddy Fork of Silver Creek, a result of the geologic and topographic condition along the Knobstone escarpment. States that conditions are favorable for the continuance of such piracy until balanced conditions of gradients of the streams affected are reached. Adjustments of tributaries to reversed drainage resulted in formation of bed-rock terraces at junctions with the main stream.

MANGER, G. EDWARD.

1. A mineral analysis of some common sands and their silica content. Jour. Sedimentary Petrology, vol. 4, no. 3, pp. 141-151, tables, Dec. 1934.

Compares the silica content of nine common sands calculated from mineralogic analyses with the silica contents determined by chemical analyses, and gives various conclusions.

MANN, I. J.

1. The removal of river bars by induced tidal scour. Engineering, vol. 30, p. 343, Oct. 22, 1880.

Explains the effect of induced tidal scour on river bars, and states that scouring power of current is proportionate to its velocity. Discusses the capability of running water to hold material in suspension, describes method of sampling to determine the quantity and quality of material held in suspension by tidal water in harbors, and reports use of dredges to deepen bars. Considers relative value of tidal and upland water for scouring purposes.

MANSFIELD, G. R.

1. Flood deposits of the Ohio River, January-February 1937—a study on sedimentation. U. S. Geol. Survey, Water-Supply Paper 838, pp. 693-736, illus., 1938.

A report summarizing results of a field and laboratory study, conducted on the part of the Ohio River Valley between Cairo, Ill., and Huntington, W. Va., covered by the flood of January-February 1937. This study deals with the identification of deposits ascribable to this flood, to the discovery of criteria which may be useful in the study of other flood deposits, the recognition of systematic differences in de-

posits that are related to their position, conditions of deposition, and sources of supply or other factors affecting deposits. The physiographic development of the Ohio Valley is briefly summarized. Discusses the nature of the surfaces flooded, the meteorologic conditions that produced the flood, stages reached by past floods, the examination by the U. S. Soil Conservation Service of flood damage and siltation on farm lands, the distribution of flood deposits, general nature of deposits, mechanical analyses of samples of flood deposits taken from various locations, extent of deposition, and nature of material underlying the flood deposits. Samples of Potomac River flood deposits are considered for comparison. The influence of loess on the nature of Ohio River deposits, the relations of this study to the study of earlier geologic formations, and the applications of the study to soil conservation and flood control are considered.

MANSON, MARSDEN.

1. Report on the determination of sediment held in suspension and transported by the waters of certain streams of California. Calif. State Engin., Rpt., pt. 3, pp. 66-72, 1880.

Results of observations on sediment transported by the Yuba, Bear, American, Feather, and Sacramento Rivers, showing the ratios by weight and volume found to exist between the waters of these rivers, and the sediment carried in suspension by them, at various points, at different stages, and at various times during 1878-79. Results of miscellaneous examinations of sediment-bearing waters are given, showing the ratio by weight and volume between water and suspended sediment at various breaks in the Yuba River, in the Sutter basin, and in small streams.

2. Report on the survey of Yuba River and its forks. Calif. State Engin., Rpt., pt. 3, pp. 47-63, 1880. Presents results of a survey (1878-79) to determine the conditions and extent of mining debris deposits lodged in the bed of the Yuba River and its tributaries.

MARDLES, E. W. J.

1. The viscosity of suspensions in non-aqueous liquids. Faraday Soc. Trans., vol. 36, pt. 10, pp. 1007-1017, Oct. 1940.

Determines the viscosity of suspensions over a wide range of concentrations of a finely powdered solid in several organic liquids and different solids in one liquid. A low rate of shear is allowed. Gives results obtained.

MARK, H. See Doty, P. M., 1.

MARKHAM, E. M.

1. Results of experiments looking to the development of a form of subaqueous concrete revetment for the protection of river banks against scour or erosion. Prof. Mem., vol. 8, no. 42, pp. 721-733, illus., Nov./Dec. 1916.

Describes results of experiments by the Mississippi River Commission on designs and methods for the construction of reinforced concrete revetment for bank protection on the Mississippi River.

MARPLE, ALBERT.

1. Making a stream build its own check dams. Engin. News-Rec., vol. 81, no. 8, pp. 368-369, illus., Aug. 22, 1918.

Describes the construction of porous check dams to prevent stream bank erosion by detritus carried by flood waters. Floating debris clogs up the dam, backing up water in the pond behind the obstruction. Silt deposits in the pond are formed by the dam. By using a series of dams, they may be allowed to fill successively. By using porous dam elements parallel to and across the stream, the stream bed contour can be controlled. Gives costs and designs of check dams used in Laurel Canon Creek, Calif.

MARR, ROBERT A.

1. Report of observations made at the Navy Yard at Memphis, during the months of April, May, June, and a part of July 1849. Amer. Assoc. Adv. Sci., Proc., (1849) 2, pp. 335-345, illus., 1850.

Report of observations (April-July 1849) made on the sediment of the Mississippi River at Memphis. Silt studies consisted of allowing

sediment to deposit from samples of water collected daily then drying and weighing them. Silt content was 12.7 lb. per hundred cu. ft. of water; total suspended load annually passing Memphis estimated at 2,137,061,974 cu. ft.

MARSHALL, HORACE M. See Ockerson, J. A., 1.

MARSHALL, P.

1. Colloid substances formed by abrasion. New Zeal. Inst., Trans. and Proc., vol. 59, pt. 3, pp. 609-613, Sept. 1928.

Reviews works concerned with the production of colloids by abrasion. Gives data and conclusions reached by various authors.

MARSHALL, R. M.

1. (and Brown, C. B.). Erosion and related land use conditions on the watershed of White Rock Reservoir near Dallas, Texas. U. S. Soil Conserv. Serv., Phys. Land Survey, 5, 29 pp., illus., 1939.

Results of a survey of White Rock Reservoir watershed made in 1937 to furnish information on erosional losses, which could be correlated with rate of sedimentation. Includes four pages on sedimentation and soil erosion. Describes White Rock Reservoir and dam (completed in 1910), noting a reduction in reservoir area from 1254 acres to 1150 acres by 1935, due to growth of a large delta at the head of backwater on White Rock Creek and a smaller delta on Dixon Branch. Survey by Section of Sedimentation Studies, U. S. Soil Conservation Service, in April 1935, showed reduction in capacity of 21.38 percent in 25 yr. Summarizes survey data. Gives estimated soil loss for entire drainage basin, and compares total soil loss in drainage area with the accumulation in the reservoir noting condition of erosion and deposition in stream channels and on flood plains as a result of flood currents. Data are given on streamflow, evaporation, consumptive use of water, turbidity, volume weight determinations of soil removed from watershed, order of magnitude of sediment disposal from erosion in watershed, and output of erosional debris. Notes that calculations neglect amount of material contributed by erosion of stream banks and beds.

MARSTON, ANSON. See Matthes, G. H., 6.

MARSTON, GEORGE ANDREWS.

1. Sedimentation in southern Iowa reservoirs. 75 pp., July 1933. Unpublished thesis (M. S.) - State University of Iowa; [abstract], Iowa Univ., Studies in Engin., Bul. 19, p. 57, May 1939.

Outlines the results of a field inspection of silting conditions in 18 reservoirs in southern Iowa as well as the results of a detailed sedimentation survey of Pine Lake, Iowa. Factors affecting erosion, methods of erosion control, and theory of sedimentation are discussed. Concludes that reservoirs in southern Iowa are not silting at an excessively rapid rate.

MARTEN, HENRY J. See Browne, W. R., 1.

MARTIN, F. O. See Briggs, L. J., 1.

MARTIN, IRVING L. See also Bass, T. C., 1, 2.

1. (and Bass, Turner C.). Erosion and related land use conditions on Lake Michie watershed, near Durham, North Carolina. U. S. Soil Conserv. Serv., Phys. Land Survey, 11, 19 pp., illus., 1940.

Results of a soil conservation survey by the watershed of Lake Michie, near Durham, N. C., made in 1936 and 1937, to provide information regarding the physical character of the watershed for use in connection with a sedimentation survey completed early in 1935, and also to furnish a permanent record of the physical conditions of the land as a basis for planning control of erosion and improved land use. A description of the area and methods and results of the conservation survey are given. Discusses agriculture, erosion, soils, slopes, and land use. Sedimentation survey, January 1935, revealed that after 8.75 yr. of operation, the 12,671 acre-foot reservoir had lost 3.12 percent of its capacity due to sediment accumulations, an average annual loss of 0.36 acre-foot. Calculations from conservation- and sedimentation-survey data indicate that a total of approximately 38,805 acre-feet of erosional debris had been produced in the watershed during

MARTIN, IRVING L. - Continued

the 175 yr., the period of agricultural use. Approximately 24 percent of the total erosion reached or passed the reservoir point, the remainder has been deposited on lower slopes, in fields, in small ponds, and on small alluvial fans.

MARTIN, LAWRENCE. See Tarr, R. S., 3.

MARTIN, W. F. See Clapp, W. B., 1.

MARX, C. D.

1. (and Fowler, F. H., and Paul, C. H.). Board's report ends long controversy on San Gabriel flood control project. *Mod. Irrig.*, vol. 3, no. 4, pp. 14-17, 49, 56-67, Apr. 1927.

A report presented to the Los Angeles Chamber of Commerce, March 1927, giving problems of the San Gabriel River Flood Control Project, and submitting technical details of proposed dams. Includes four paragraphs noting that the probable loss of storage capacity of reservoir in San Gabriel Canyon will amount to 400 acre-feet per year. Provisions for maximum debris storage of 5000 acre-feet would cost \$700,000 and would afford relief for only 12 yr. Recommends use of check dams in higher tributaries and restraining dams in larger channels to prevent deposition of debris in main reservoir.

MASON, ARTHUR J. See Wisner, G. Y., 1.

MASON, MARTIN A. See also Kalinske, A. A., 2; Vanoni, V. A., 5; Wilm, H. G., 1.

1. A manometric settling-velocity tube. *Amer. Geophys. Union, Trans.*, vol. 30, no. 4, pp. 533-538, illus., Aug. 1949.

Describes a preliminary design of a manometric settling-velocity tube. Develops a theory for a manometric settling-velocity tube which allows a rapid accurate determination of still-water settling velocities of sand-size sediments.

MASON, MAX. See also Mendenhall, C. E., 1.

1. (and Mendenhall, C. E.). Theory of the settling of fine particles. *Natl. Acad. Sci., Proc.*, vol. 9, no. 6, pp. 202-207, illus., June 1923.
Gives results of observations dealing with the settling of fine particles. Points out that stratified subsidence occurs only when convection currents are present and that convection currents are the primary cause of stratified subsidence. Treats an attempt to connect quantitatively the various conditions with position of layers formed after aging and with fall velocity of a boundary surface.

2. (and Weaver, Warren). The settling of small particles in a fluid. *Phys. Rev.*, (ser. 2) vol. 23, no. 3, pp. 412-426, illus., Mar. 1924.

Presents a mathematical theory for the settling of small particles in a fluid. Notes that small particles immersed in a liquid experience a motion which is a combination of the Brownian movement and a steady gravitational drift. Points out that the Brownian movement produces a diffusion which tends to equalize the density, providing there are space variations in the density of the distribution of particles. The density of particles is an exponential function of the distance below the surface of a liquid in the steady state. The manner in which the steady state is produced is investigated by this report.

MASON, WILLIAM P.

1. *Water Supply*. Ed. 4, 528 pp., illus. New York, John Wiley and Sons, 1916.

Deals with the various problems of water supply. Comments on discharge and sediment of streams and sedimentation in reservoirs.

MASSACHUSETTS STATE PLANNING BOARD.

1. *Westfield River*. Mass. State Planning Bd., Drainage Basin Study 6, 84 pp., illus., 1939.

A report dealing with the problems of floods, water supply, drainage, sewerage, and navigation, etc., in the Westfield River, Mass. Conditions of bank erosion and sedimentation in the stream channel are briefly described.

MATHER, W. W.

1. Alluvial action—action of rivers. *Ohio Geol. Survey, Ann. Rpt.* (1837) 1, pp. 5-129, illus., 1838.

Due to cutting of trees on banks and passing of

steamboats, the banks of the Muskingum River at Marietta, Ohio, have washed away, causing the river to become double the width existing here at the time it was first settled, and causing the original rock bed to be filled with sand and gravel to a depth of 12 ft.

MATHEWSON, T. K.

1. Sand traps in a power canal [letter to editor]. *Civ. Engin.*, vol. 4, no. 11, p. 599, illus., Nov. 1934.

Illustrated letter on special desilting devices used in South American hydroelectric development to control rock, sand, and silt brought down by melting snows. Originally, hopper in forebay is controlled by hardwood clean-out valves. In new plant, valves are eliminated, and discharge obtained through 4 in. sewer pipes. Hoppers effectively clear water of sand, gravel, and stones.

MATTHES, FRANCOIS E. See Freeman, J. R., 3; Matthes, G. H., 5.

MATTHES, GERARD H. See also Coldwell, A. E., 2; Hathaway, G. A., 1; Hinds, N. E. A., 1; Kramer, H., 2; Senour, C., 2; Sonderegger, A. L., 2.

1. Tennessee River and tributaries, North Carolina, Tennessee, Alabama, and Kentucky. 67th Cong., 2d sess., H. Doc. 319, pp. 85-117, 1922.

Considers several subjects which have important bearings on a proposed survey of the Tennessee River and its tributaries. Includes discussion on the regimen of the Tennessee River and the factors which may possibly modify existing conditions of equilibrium.

2. Diversion of sediment at branching channels. *Amer. Geophys. Union, Trans.*, vol. 14, pp. 506-509, June 1933.

Paper on laboratory studies relative to the diversion of bed load at stream forks. Notes model experiments of Thoma, Bulle, and Rehbock who succeeded in diverting high percentages of bed load for different bifurcation angles into a branch channel while admitting a 50 percent constant ratio of diverted water. Similar experiments at U. S. Waterways Experiment Station of the Mississippi River Commission are described. Experiments relative to the diversion of bed load at a channel fork with subsequent return of diverted flow into the main channel and with partial permanent abstraction of river discharge are reported. Bed-load movement in channels influenced by reversible flow are proposed for study, noting in particular conditions to be met with in silt-bearing streams and other factors which may influence bed load diversion.

3. Floods and their economic importance. *Military Engin.*, vol. 26, no. 148, pp. 265-268, illus., July/Aug. 1934; also in *Amer. Geophys. Union, Trans.*, vol. 15, pp. 427-432, 1934; [abstract], *Civ. Engin.*, vol. 5, no. 12, p. 12, Dec. 1935.

A paper read at the annual meeting of the American Geophysical Union, April 1934, on floods and their economic importance. Discusses creative functions of floods, such as the periodic removal of debris accumulations in stream channels, the deposition of its finer silt burden creating alluvial lands of great fertility, the maintenance of this fertility, the rebuilding of banks of meandering streams, and the building up of delta lands. Discusses the limit beyond which flood regulation must not be carried, noting that such regulation if properly planned need not interfere with debris removal from stream beds. The resistance to removal offered by sedimentary deposits that have become compacted is considered, noting that materials which are most readily transported by water are those which offer the greatest resistance to movement after they have become compacted. Gives agencies active in compaction of sedimentary debris. Discusses the maintenance of channels by high stages of water, and the effect of floods in scouring deposits, bank caving, and channel shifting. Notes the behavior of deposits at mouths of large tributaries. Most effective forms of kinetic energy affecting debris removal are turbulence, tractive force, and abrasion, and these are most efficient at high stages. Results of river development causing deterioration of river channel by loss of

carrying capacity for water and solids, and by excessive bed erosion caused by lack of sufficient bed load needed to use up the kinetic energy normally expended in debris transportation discussed. Notes the effects of levees, canals, retarding basins, cut-offs, reservoirs, and dams on stream regulation. Discusses conditions necessary to predetermine effect of flood curtailment.

4. Basic aspects of stream meanders. Amer. Geophys. Union, Trans., vol. 22, pt. 3, pp. 632-636, illus., Aug. 1941.

Sets forth certain fundamentals relating to the dynamics of meandering streams derived from observations on streams of various sizes. The following variables which appear to be basic factors in river meandering are described and discussed: valley-slope, bed-load, discharge, bed-resistance, and transverse oscillation.

Discussion: G. W. HOWARD, p. 636, notes two mathematical treatises which have been published. States that no mention was made of the effect of the earth's rotation upon lateral erosion.

5. Macroturbulence in natural stream flow. Amer. Geophys. Union, Trans., vol. 28, no. 2, pp. 255-262, Apr. 1947.

Discusses six types of macroturbulence phenomena in natural streams. Introduces a new term "kolk" to supplement a deficiency for designating upward vortex action. Points out that the vortex action of the upward-flowing kolk type is a powerful form of energy at work on beds of streams and is a major agency in bank caving, scour, stream-bed morphology, and sediment transportation.

Discussion: FRANCOIS E. MATTHES, pp. 262-265, comments on observations made on the Potomac River at the Great Falls above Washington and in the gorge below the falls. Concludes that these observations bear out the soundness of the central idea of macroturbulence concerned with the idea that the energy of whirling eddies and vortices is largely responsible for the eroding power of a stream. B. HELLSTROM, (Amer. Geophys. Union., Trans., vol. 29, no. 2, pp. 272-274, Apr. 1948), describes apparatus used in measuring the direction of helicoidal flow in small rivers. Notes flume studies in Sweden. R. ROBINSON ROWE, pp. 274-275, describes a vortex in the Colorado River and notes the erosion from macroturbulent processes. THE AUTHOR, pp. 275-277, notes various points presented by the discussers.

6. Mississippi River cut-offs. Amer. Soc. Civ. Engin., Trans., vol. 113, pp. 1-15, illus., 1948; also in Amer. Soc. Civ. Engin., Proc., vol. 73, no. 1, pp. 3-17, illus., Jan. 1947.

Describes natural and artificial cut-offs in the lower Mississippi River along a 50-mile stretch north of Vicksburg, Miss. Notes historical and physical facts concerning cut-offs. Gives the effect of cut-offs on river shortening and flood-stage lowering. The data presented are from the records of the Mississippi River Commission.

Discussion: W. E. ELAM, pp. 16-17, comments on previous problems concerned with flood control and navigation. Notes the job done by the river in carrying detritus out of the channel. C. L. HALL, pp. 17-18, notes some questions on cut-offs which need to be answered. H. D. VOGEL, pp. 18-20, comments on cut-offs and notes work by Gen. T. H. Jackson, Gen. Ferguson, and Mr. Matthes. HARRY N. PHARR, pp. 20-21, comments on cut-offs. Notes plan of James B. Miles. LYTLE BROWN, pp. 21-22, treats idea of artificial cut-offs, and work of A. H. Humphreys and Henry L. Abbot. Notes the Jadivin Plan. ANSON MARSTON, pp. 22-24, makes various comments on cut-offs and notes several points on which information is desired from the author. E. J. WILLIAMS, JR., and EUGENE A. GRAVES, pp. 24-27, give low-water profiles before and after cut-offs. Give high-water slope data. THE AUTHOR, pp. 27-39, comments on points brought out by the discussers. Adds additional information on

cut-offs and answers questions and requests for further information by the discussers on the problem of cut-offs.

7. Solids in stream flow. Amer. Geophys. Union, Trans., vol. 30, no. 3, pp. 421-426, June 1949.

Points out that the natural-solids load of streams has a stabilizing influence on maintaining stream channels and that dissolved solids are a definite part of the sediment load, settling out being due to evaporation and chemical reaction. Notes that because of this it should have recognition in the definition of regimens. Considers retrogression and aggradation below dams such as in the Rio Grande below Elephant Butte Dam and in the Colorado River below Hoover Dam. Points out conditions which caused the "Needles Swamp." Considers the seriousness of the problem of stream-channel deterioration.

MATTHEWS, E. R.

1. The silting of harbors [abstract]. Engin. News, vol. 70, no. 14, p. 644, Oct. 2, 1913.

A paper presented at meeting of British Association for the Advancement of Science on the silting of harbors and effect of piers and jetties on movement of sand along shore line. Harbor arms extending at right angles to coast induce sedimentation on one side and erosion on the other side. Sea front at Yarmouth, England, extended an average of 300 ft. in 50 yr. At Madras, India, 650,000,000 cu. ft. of sand accreted on south side of harbor and 450,000,000 cu. ft. eroded on north side. Proposed extension of harbor seaward to reduce silting not always satisfactory. Author proposes construction of piers at 45° so that travelling material would pass around harbor projection and supply coast on lee sides with natural protection of sand.

2. Bars and sandbanks: their formation and movements. Inst. Munic. and Co. Engin., Proc., vol. 41, no. 12, pp. 765-775, Apr. 1915.

Considers the formation of bars and sand banks in river estuaries, in bays, in deltas, and in sheltered positions along the sea coast. Describes formation of bars due to wave action and tidal action in depositing material from the sea and sea coast, and the effect of wave and tide in depositing the silt carried in rivers when river meets the sea. Refers to instances and causes of erosion and accretion at Thornwick Bay, North Sea sand banks, Goodwin Sands, Sunk Island (in the Humber estuary), Sheppey Island (in the Thames estuary), clay cliffs at Warden, streams in Middlesex, Mississippi Delta, Ganges River, Mersey estuary, Chesil Bank, Bank of Newfoundland, Sunderland, Algiers, Bridlington, Southport, Morecambe Bay, Shoreham (near outlet of River Adur), Wash estuary, and Ribble estuary. Gives evidence that wave action is felt at greater depths than most theorists believe, citing movement of material along sea bed by wave action at a depth of eight fathoms.

MATTHIAS, N. A.

1. The Los Angeles Flood Control Project. Military Engin., vol. 33, no. 191, pp. 382-388, illus., Sept. 1941.

Discusses the flood control problem and describes the types of work of the Los Angeles Flood Control Project. The regulation of floods from the larger canyons to the capacity of downstream channels is being accomplished by the construction of flood control and debris basins in foothill and valley areas, and by extensive and varied channel improvements.

MAVIS, F. T. See also Kramer, H., 2.

1. (editor). Two decades of hydraulics at the University of Iowa; abstracts of theses, publications, and research reports, 1919-1938. Iowa Univ., Studies in Engin., Bul. 19, 80 pp., 1931.

Includes abstracts of theses, publications and research reports concerned with sedimentation (pp. 56-61).

2. (and Ho, Chitty, and Tu, Yun-Cheng). The transportation of detritus by flowing water. I. Iowa Univ., Studies in Engin., Bul. 5, 52 pp., illus., 1935; [abstract], Engin. News-Rec., vol. 115, no. 13, p. 434, Sept. 25, 1935; Iowa Univ., Studies in Engin., Bul. 19, p. 58, May 1939.

Critically reviews literature dealing with investigations on the transportation of solids by flowing water. Presents results of an analysis of investigations conducted in the laboratory of the Iowa Institute of Hydraulic Research relative to some of the problems of transportation of solid particles which are rolled or dragged along the bottom of a channel in traction. Presents data on selected laboratory and field studies by various investigators in connection with (1) the competent velocities for ungranular material of different sizes, (2) the relationship between the size of a particle and the competence for traction, and (3) the relationships between the phenomena of stream flow and the nature, extent, and amount of movements of detritus. Reports experiments carried on at the Iowa Institute of Hydraulic Research. Describes apparatus and materials, methods of procedure, observations on competence, velocity distributions where competent conditions are reached, and effect of diagonal strips on floor of channel upon competent bottom velocities. Gives conclusions.

3. Research notes - Hydraulic research at Iowa University. Engin. News-Rec., vol. 115, no. 13, pp. 433-437, illus., Sept. 26, 1935.

An article which describes the hydraulic laboratory at the University of Iowa. Gives abstracts of research studies concerned with sedimentation during 1934-35.

4. (and Liu, Te-Yun, and Saucek, Edward). The transportation of detritus by flowing water. II. Iowa Univ., Studies in Engin., Bul. 11, 28 pp., illus., Sept. 1, 1937; [abstract], Iowa Univ., Studies in Engin., Bul. 19, pp. 58-59, May 1939.

Gives data on the transportation of bed load by flowing water comparing quantitatively relationships based on the assumptions that bed-load movement is dependent upon the velocity of water at the bed of the stream or upon the tractive force which in turn is dependent upon depth of flow and slope of water surface. Describes experiments, giving attention to apparatus and materials, procedure, observations on rates of bed-load transportation for known flume slopes, corresponding water-flow rates, depths, velocity distributions, and material movements. Discusses the determination of the roughness factors in Manning's formula, and the derivation of empirical formulas of bed-load movement.

5. (and Laushey, L. M.). Formula for velocity at beginning of bed-load movement is reappraised. Civ. Engin., vol. 19, no. 1, pp. 38-39, 72, illus., Jan. 1949.

Gives an outline of physical variables which make up competence. Plots data reported between 1786 and 1914 to illustrate formula for competent bottom velocity proposed by the author in 1935. Gives a simpler formula for competent bottom velocity. Recent data, 1914-37, are plotted also. Makes various comments on the reappraisal of competent velocity as the primary criterion of the beginning of bed movement.

MAXSON, JOHN H.

1. (and Campbell, Ian). Stream fluting and stream erosion. Jour. Geol., vol. 43, no. 7, pp. 729-744, illus., Oct./Nov. 1935.

Presents results of observations on a study of the process of stream fluting, or the formation of longitudinal grooves (flutes) in stream beds due to swift moving sand or silt-laden water currents. Stresses the importance of this process in fluvial erosion and analyzes observations in the inner gorges of the Grand Canyon. Cites earlier observations by M. Lugeon, E. D. Elston, and others, on the fluting process. Conditions of erosion and the transportation of debris in the Colorado River are described. Notes that dissolved and suspended load determinations in the Grand Canyon section of the Colorado River indicate that streams carry sufficient fine debris at a velocity effective in abrading the bedrock and boulders of the channel. Turbulence in erosional phenomena in a natural channel is considered. Discusses the

process of stream fluting, types of flutes, rate of fluting, stream and eolian fluting, and the geologic significance of turbulent motion in corrosion.

2. Gas pits in non-marine sediments. Jour. Sedimentary Petrology, vol. 10, no. 3, pp. 142-145, illus., Dec. 1940.

Points out that the generation of the natural gas methane during the decomposition of organic debris is responsible for a minor phenomenon of sedimentation termed "gas pits" with surrounding mud mounds. Erosion in the vicinity of active gas-bubble agitation forms larger crater-like pits in submerged mud and silt bars. Describes gas pits in mud bars at the headwaters of Lake Mead observed in November 1937.

MAXWELL, GEORGE H.

1. The control of non-navigable streams by the national government. Amer. Soc. Civ. Engin., Trans., vol. 49, pp. 32-43, Dec. 1902.

A discussion on the control of non-navigable streams by the national government. Includes two paragraphs noting that the channel of Sacramento River has been filled up with silt and debris from hydraulic mines, hampering navigation. Proposes the use of a great overflow channel constructed through the "Trough," and canal on the western side of the Sacramento Valley, to debouch silt, debris, and sediment into the Suisan Bay. Suggests that sediment could be deposited over salt marshes, to reclaim land for agricultural and grazing purposes.

MAY, ROSS R. See Elliot, S. F., 1.

MEAD, DANIEL W. See also Dappert, J. W., 1; Sibert, W. J., 1.

1. Notes on the hydro-geology of Illinois in relation to its water supply. Ill. Soc. Engin. and Surveyors, Ann. Rpt., 8, pp. 48-68, 1893.

Deals with the geology of Illinois in relation to its water supply. Includes brief data on suspended- and dissolved-load determinations of river waters in the Illinois River Basin, of the Mississippi and the Rock Rivers, and of various other surface, spring, and well waters in Illinois.

2. The hydro-geology of the upper Mississippi Valley and of some of the adjoining territory. Assoc. Engin. Societies, Jour., vol. 13, no. 7, pp. 329-396, illus., July 1894.

Gives hydrological data and describes the geological characteristics of the upper Mississippi Valley and some of the adjoining territory. Includes brief data on dissolved and suspended matter in the river waters of the Illinois River Basin and of the upper Mississippi River.

3. Report on the dam and water power development at Austin, Texas... November 1917. 205 pp., illus. Madison, Wis., 1917.

Discusses the economic aspects of the reconstruction of Austin Dam which failed in 1900, and critically evaluates the plan and structure of the new dam. Reports the silting of the reservoir behind the old Austin Dam and gives brief data on the extent and rate of silt accumulations in the reservoir from May 1893 to January 1900. The nature of the silt is briefly described.

4. Hydrology, the fundamental basis of hydraulic engineering. 647 pp., illus. New York, McGraw-Hill Book Co., 1919.

Deals with utilization and control of water, winds and storms, evaporation, precipitation, rainfall measurements and records, stream flow and runoff data, and floods and flood control. Notes importance of water in agricultural practice. Includes discussions on corrosion, the transportation and deposition of erosional debris by streams, the average amounts of matter in solution and in suspension carried by various rivers of the United States (1906-07), the rates of land surface reduction based on discharge of sediment by large rivers, the origin and development of drainage valleys, and the origin of falls and rapids.

5. The Boulder Canyon project. Wis. Engin. Soc., Ann. Rpt., 21, pp. 86-109, illus., 1929.

Describes the various engineering features of the Boulder Canyon project. Briefly notes the effect of its construction upon silt deposition above the dam and upon silt conditions below the dam. The effect of silt deposits upon reservoir capacity is also noted.

6. The Colorado River and its proposed development. *West. Soc. Engin. Jour.*, vol. 34, no. 7, pp. 397-422, illus., July 1929.

Article describing the Colorado River, Boulder Dam, and the All-American Canal. Gila River, Salton Sink, Black Canyon, and Gulf of California, as well as the irrigation, flood control, and water-power aspects of projects on the Colorado River are discussed. History of river development and the geological history of the river are given. Silt load of the Colorado at Yuma estimated at 113,000 acre-feet per year, while Fortier and Blaney (Fortier, S., 3) estimate 137,000 acre-feet per year. Silt removed from Imperial Irrigation District main canals in 1927 was 4,341,000 cu. yd. at a cost of \$586,767. Including lateral ditches cost is \$1,300,000 per annum. Annual cost of clearing 970,000 cu. yd. of silt from canals of Yuma District below Laguna Dam is \$106,000. Effect of sedimentation in altering course of the Colorado River is reported. At Yuma, bed will erode 21 to 36 ft. during high water. Early river gaging measurements at Yuma are uncertain and probably too high. Provision is made for silt pocket in the Boulder Reservoir. Life expectancy of the reservoir, and anticipated retrogression downstream of Boulder Dam are considered.

MEAD, ELWOOD. See also Robinson, H. F., 1.

1. Irrigation studies. *Amer. Soc. Civ. Engin., Trans.*, vol. 44, pp. 149-175, illus., Dec. 1900.

Presents extracts from a technical report of the U. S. Department of Agriculture, Office of Experiment Stations, for 1899, relating to the irrigation problems throughout the United States. Includes one paragraph pertaining to sediment investigations that revealed certain southern streams carry during floods as high as 5 percent of solid matter in suspension, necessitating repeated cleaning of canals and laterals which draw water from them. Notes operation of sluicing devices which removes accumulated sediment from weirs.

2. Irrigation in the United States. *U. S. Off. Expt. Sta., Bul.* 105, 47 pp., illus., 1901.

Testimony before the United States Industrial Commission, June 11-12, 1901, dealing with the various aspects of irrigation engineering in the United States. Includes brief discussion on the filling up of irrigation canals with silt; examples are cited.

3. Report on irrigation investigations for 1900—Review of investigations. *U. S. Off. Expt. Sta., Bul.* 104, pp. 13-20, 1902; [abstract], *Engin. News*, vol. 48, no. 12, p. 208, illus., Sept. 18, 1902.

A report on methods of conserving, using, and distributing water in irrigation. Gives table (from investigations by Prof. J. C. Nagle), showing average percentages of silt carried by the Brazos, Pecos, Laramie, Rio Grande, Salt, and Wichita Rivers.

4. (and others). The All-American Canal, report of the All-American Canal Board, 1919. 98 pp., illus. Washington, 1920.

W. W. Schlecht, C. E. Grunsky, and Porter J. Preston, joint authors.

A report of the All-American Canal Board which is concerned with data on the construction of a canal in the United States, extending the Colorado River at the Laguna Dam into the Imperial Valley, Calif. Considers the silt problem of the Colorado River. Includes a table which gives data on the silt contents of the Colorado River at Yuma, 1909 to 1918.

5. (and Beach, Lansing H., and Anderson, W. E.). Report of the American Section of the International Water Commission, United States and Mexico. *U. S. 71st Cong., 2d sess., H. Doc.* 359, pp. 1-29, 1930.

Presents results of a study regarding the equitable use of the waters of the lower Rio Grande, lower Colorado, and Tia Juana Rivers. Includes discussion on the silt problem in the lower Colorado River.

6. Silt in Boulder Dam [letter to editor]. *Reclam. Era*, vol. 25, no. 9, p. 176, Sept. 1935.

Letter to the editor on the silting of Boulder Dam reports that the reservoir has a capacity of 30,500,000 acre-feet; five to eight million acre-foot silt pocket provided. Annual rate of silting estimated at 137,000 acre-feet which would take 150 yr. to fill silt pocket, and centuries to fill lake. Silt surveys are to be made. Other dams are eventually to be built above Boulder. The purpose of the dam is to desilt the Colorado River, and to relieve irrigators an expense of \$1,000,000 a year to maintain the canals. Water in reservoir is clear, indicating silting at head of lake, but not near the dam.

MEAD, J. R.

1. A dying river. *Kans. Acad. Sci., Trans.*, vol. 14, pp. 111-112, 1894.

Describes the regimen of the Arkansas River prior to and after settlement by white men. Considers also, the effect of settlement upon condition of stream flow, and upon sediment transportation and deposition. The characteristics of deposited silt are noted.

MEAD, TOM C.

1. Technical investigations at Boulder Dam. *Reclam. Era*, vol. 30, no. 6, pp. 162-165, illus., June 1940.

Investigations at Boulder Dam regarding mass concrete, seepage, and density currents. Discusses current investigations on the stratification and deposition of silt in the reservoir and in the stream above.

MEAD, WARREN J. See also Sibert, W. J., 1.

1. Engineering geology of dam sites. *Internatl Cong. on Large Dams*, 2, vol. 4, pp. 171-192, 1936.

Deals with the geology of foundation materials at dam sites. Calls attention to the properties of alluvial deposits of sand and silt as foundation material for earthen dams, and to the compaction and porosity characteristics of deposited sand and silt.

2. Geology of dam sites in shale and earth. *Civ. Engin.*, vol. 7, no. 6, pp. 392-395, illus., June 1937.

Considers shale, cemented shale, and silt foundations for dams. Preparation of shale foundations, types of dam foundations, and properties of clays are discussed. Compaction of sand and silt is dependent on rate of application of load and on means for escape of water in the sand or silt.

MEADOR, A. A. See Bloodgood, D. W., 1, 3-8.

MEANS, THOMAS H. See also Witzig, B. J., 1.

1. (and Gardner, Frank D.). A soil survey in the Pecos Valley, New Mexico. *U. S. Dept. Agr., Rpt.*, 64, pp. 36-76, illus., 1900.

Notes that soil of the Hondo meadow land is formed from recent alluvium; compares the fertilizing value and chemical composition of the Nile and Hondo Rivers silt; gives data on the mechanical analyses of soils of the Hondo meadows; the chemical composition of North and South Spring Rivers; and the average composition of soluble matter in the Pecos, at Carlsbad.

MEEKER, R. I. See Taylor, T. U., 6.

MEES, C. A.

1. Kennedy's laws of silting [letter to editor]. *Engin. News*, vol. 65, no. 23, p. 701, June 8, 1911.

Letter to editor and editorial response commenting on Three Irrigation Projects in the Punjab, India (Segur, A. B., 1). Requests data on relation between V_c (critical velocity) and p (silt carried at V_c). Editor's response quoting R. G. Kennedy's paper entitled The Prevention of Silting in Irrigation Canals (Kennedy, R. G., 1) notes the existence in any stream of critical velocity at which all silt in suspension is carried without deposition and at which velocity no scour occurs (formula given). Formula is of value in determining amount of silt to be deposited or scoured, or in designing the proper sized laterals and canals.

MEGINNIS, H. G. See Munns, E. N., 3.

MEHMEL, MARTIN.

1. Application of X-ray methods to the investigation of Recent sediments. In Trask, P. D., ed. *Recent marine sediments: a symposium*, pp. 616-630, illus. London, T. Murby and Co., 1939.

Describes X-ray methods pertinent to the study of Recent sediments with special reference to

MEHMEL, MARTIN. - Continued

the identification of the mineral components of the clayey fractions of the sediments. Limitations and applications of method are discussed. References are cited.

MEIJERS, A. A.

1. The silt question in reservoirs. Roy. Inst. Engin., Netherlands India Branch, Jour., 1913.
Discusses general problems encountered in the study of reservoir silting. Notes the problem of silting in the Hamiz, Habra, and Djidonia Reservoirs in Algeria. Notes rate of sedimentation in the preparation of a plan for the Engle Reservoir in New Mexico on the Rio Grande. Presents data on reservoir sedimentation in Algeria, the United States, Italy, India, Egypt, etc. Considers various methods of sluicing. Different cleaning methods are mentioned, such as cleaning reservoirs by removal of earth, by the method of Jandin, and by the method of Calmels.

MEINZER, OSCAR E.

1. Geology and water resources of Estanica Valley, New Mexico. U. S. Geol. Survey, Water-Supply Paper 275, 89 pp., illus., 1911.
In addition to detailed data on the geology and water resources of Estanica Valley, N. Mex., notes briefly present conditions of the building up of arroyo bottoms with deposited sediment.
2. Physiography and drainage, Sulphur Spring Valley, Arizona. U. S. Geol. Survey, Water-Supply Paper 320, pp. 20-43, illus., 1913.
Describes the general physiographical and drainage features of the Sulphur Spring Valley, Ariz. Includes discussion on recent conditions of erosion and deposition in the Gila and Sulphur Spring Valleys, noting the occurrence of ridges composed of marginal deposits formed by flood streams on the lower slopes of the Sulphur Spring Valley.
3. (and Hare, R. F.). Geology and water resources of Tularosa Basin, New Mexico. U. S. Geol. Survey, Water-Supply Paper 343, 317 pp., illus., 1915.
A report dealing with the geology and water resources of the Tularosa Basin, N. Mex. Includes brief discussion on the origin and characteristics of the arroyos in the basin.
4. Geology and water resources of Big Smoky, Clayton, and Alkali Spring Valleys, Nevada. U. S. Geol. Survey, Water-Supply Paper 423, 167 pp., illus., 1917.
Deals with the geology and water resources of Big Smoky, Clayton, and Alkali Spring Valleys, Nev. Includes brief data on suspended and dissolved loads of streams in Big Smoky Valley.

MELCHERS, HENRY M.

1. River regulation by suspended fascines in Bavaria. Engin. News, vol. 35, no. 13, pp. 214-215, illus., Mar. 26, 1896.
Describes channel regulation in the River Isar, Bavaria, by a method of artificial erosion and deposition activated and controlled through the use of suspended and submerged fascines. Describes sequence of engineering in carrying out the regulation works.

MELI, J.

1. Silting operations—report...on the working of the Sangla silting reaches from August 1897 to September 1900. Punjab. Pub. Works Dept., Irrig. Branch, Papers 5, pp. 32-43, Jan. 12, 1901.
Report on the working of the Sangla silting reaches, Lyallpur Division, Chenab Canal, from August 1897 to September 1900. Data on extent of silt deposits in lakes are given.

MELTON, F. A.

1. An empirical classification of flood plain streams. Geog. Rev., vol. 26, no. 4, pp. 593-609, illus., Oct. 1936.
Presents an empirical classification of flood plain streams according to geologic accomplishments on the flood plains. Recognizes three types of single crest streams which, during floods alter their geologic environment in only one way, by building (1) a meander plain; (2) an alluvial plain derived from suspended load; and (3) a bar plain derived from both tractional and suspended loads. Describes meander plain as scroll, bar and lacine. Discusses causes of different flood plain activity

and considers geologically effective floods. Observes dominant processes in double-crest streams. Notes limitations of the proposed classification. Cites examples of different types.

MENARD, HENRY W.

1. Synthesis of sand mixtures. Jour. Sedimentary Petrology, vol. 19, no. 2, pp. 71-77, illus., Aug. 1949.
Offers a method for synthesizing sand mixtures with normal probability size-frequency distribution and for any mean and sorting desired. Method can be used for certain phi standard deviations and for any phi mean diameter. Presents graphical and mathematical solutions so that any normal sand may be mixed.

MENDELL, G. H. See Wisner, G. Y., 1.

MENDENHALL, C. E. See also Mason, M., 1.

1. (and Mason, Max). The stratified subsidence of fine particles. Natl. Acad. Sci., Proc., vol. 9, no. 6, pp. 199-202, illus., June 15, 1923; [abstract], Natl. Res. Council, Div. Geol. and Geog., Com. on Sedimentation, Rpt. 1923, pp. 53-54.
A study of conditions which produced a stratified subsidence of fine particles of Cucuracha rock (from the Panama Canal), glass, or quartz in water. Concludes that strata are produced when there is a vertical density gradient due to more rapid subsidence of larger particles in combination with a lateral temperature gradient. Notes that convection is the primary cause of stratified subsidence.

MENDENHALL, WALTER C.

1. The hydrology of San Bernardino Valley, California. U. S. Geol. Survey, Water-Supply Paper 142, 124 pp., illus., 1924.
A paper on hydrology of San Bernardino Valley, Calif. Includes brief discussion on the character of the alluvial fans in the valley.

MERRILL, WILLIAM E. See also Crowell, J. F., 1.

1. The Ohio River floods [letter to editor]. Engin. News, vol. 11, p. 137, Mar. 22, 1884.
Notes that deforestation on level land does not add to floods, it is only when hills and mountains lose their cover that the soil washes away and chokes the water courses. The river bed of the Ohio has widened due to bank erosion, except at Cincinnati, where the area has been contracted, presumably by piers, etc. Cites as evidence of lack of aggradation of river channel that no sand or gravel was deposited on rocks in river bed at Louisville and at the mouth of the Licking. Discusses means for protecting Cincinnati from damage due to floods.

MERRIMAN, THADDEUS. See Rothery, S. L., 4.

MERRIMAN, THOMAS. See Grunsky, C. E., 5.

METCALF, LEONARD.

1. [Review of] Report of the Charles River Dam Commission. Tech. Rev., vol. 5, no. 4, pp. 455-469, Oct. 1903.
A report relative to the feasibility of constructing a dam on the Charles River, at site of the old Craigie Street Bridge. Includes brief discussion on the effect of the proposed dam upon conditions of scour and silting in the Boston Harbor.

MEYER-PETER, EUGENE.

1. (and Favre, H., and Einstein, H. A.). Neuere versuchsresultate über den Geschiebetrieb (New experimental results on the transport of debris). Schweiz. Bauzeitung, vol. 103, no. 12, pp. 147-150, Mar. 31, 1934. In German. Translation on file at the U. S. Soil Conservation Service, Washington, D. C.
Discusses the results of investigations carried out since 1932 at the Hydraulic Experimental Station, Switzerland, on transportation of bed load of uniform grain size. Discusses laws of transportation of bed load and formulas for calculating bed-load movement under actual conditions.
2. (and Favre, Henry, and Müller, Robert). Beitrag zur Berechnung der Geschiebeführung und der Normal-profilebreite von Gebirgsflüssen (Contribution to the calculation of the bed load carried and the normal width of profile in mountain streams). Schweiz. Bauzeitung, vol. 105, no. 9, pp. 95-99; no. 10, pp. 109-113, 1935. In German. Translation on file at the U. S. Soil Conservation Service,

Washington, D. C., and the University of Minnesota, Minneapolis, Minn.

States that the problems to be solved are the calculation of the annual bed load of a mountain stream with an artificially stabilized channel and the determination of the longitudinal profile of a regulated mountain stream in which the annual bed load is known and the cross-section is assumed or the cross-section is determined from known bed load and longitudinal profile. Revises and amends existing formulas and considers the problems solved in principle. Assistance of experiments and measurements in nature are needed for some of the details which are not solved mathematically.

MEYERS, J. S.

1. Density currents in the Panama Canal. Panama Canal Dept. Oper. and Maintenance, Spec. Engin. Div., Isthmian Canal Studies, Memo. 298, 10 pp., illus., May 26, 1948.

Presents the results of measurements of density flows in the existing Panama Lock Canal and notes the density of flow conditions in a proposed sea-level canal. Treats briefly of the existing knowledge of density currents. Tests were performed to determine the probable effect of the admission of fresh water from small watersheds.

MICHAILOV, A. P.

1. Investigations of silting of Leninakhan Hydroplant. Sci. Res. Inst. Hydrotechnics, Trans., vol. 6, pp. 167-190, 1932. In Russian with an abstract in English. Translation on file at the U. S. Soil Conservation Service, Washington, D. C.

Reports on observations by the Scientific Institute of Amelioration on the effectiveness of engineering works for the exclusion of sediment from the Leninakhan hydroelectric plant, U. S. S. R.

MIDDLEBROOKS, T. A. See Campbell, F. B., 1.

MIDDLETON, H. E. See Olmstead, L. B., 1.

MIDDLETON, R. J. See Fristoe, R. E., 1.

MIDDLETON, T. H. See Buck, Sir E. C., 2.

MIDGLEY, A. R. See Dunklee, D. E., 1.

MILL, H. R.

1. (and Ritchie, T. Morton). On the physical conditions of rivers entering a tidal sea; from observations on the Spey. Roy. Soc. Edinb., Proc., vol. 13, pp. 460-485, illus., 1885-86.

Results of observations on the physical conditions of rivers entering a tidal sea as illustrated by the River Spey, Scotland. Conditions of stream erosion and the transportation and deposition of erosional debris at the mouth of the stream are described.

MILLARD, M. K.

1. Decanting muddy lake water. Engin. News-Rec., vol. 121, no. 10, p. 310, Sept. 8, 1938.

An item on the underflow of silt through the reservoir impounded by a concrete gravity dam on Six Mill Creek, near Clemson College, S. C., noting that clay-burdened water from cloud-burst during May dropped to a lower level leaving clear water on surface. Based on this observation, gates controlling bleeder pipes in the dam, 40 ft. below crest are opened to allow discharge of muddy water. This allows the maintenance of a clear body of water under all conditions except those of heavy rains accompanied by high winds.

MILLER, M. F. See Duley, F. L., 1.

MILLER, ROBERT L.

1. A simple volumeter. Jour. Sedimentary Petrology, vol. 18, no. 1, pp. 43-45, illus., Apr. 1948.

Describes the method of construction and operation of a simple volumeter. The apparatus measures volume by direct reading and can be used in the study of pebbles.

MILLER, W.

1. (and M'Inally, T. W.). Falling velocities of minerals through water. Glasgow Roy. Tech. Col., Jour., vol. 3, pt. 4, pp. 682-689, Jan. 1936.

Presents results of tests on the effect of shape on the settling velocity of particles in water. Tests the Rayleigh theory of fluid resistance for settling velocities of irregular particles and compares results with those established for smooth spheres. Tests on the suspension of particles by rising currents of water indicate that turbulence tends to reduce the resistance to fall of bodies in water.

MILLIKAN, ROBERT ANDREWS.

1. Stokes' law of fall completely corrected. Natl. Acad. Sci., Proc., vol. 9, no. 3, pp. 67-70, Mar. 1923.

A mathematical treatment which summarizes conclusions reached in studies dealing with Stokes' law.

2. The general law of fall of a small spherical body through a gas, and its bearing upon the nature of molecular reflection from surfaces. Phys. Rev., (ser. 2) vol. 22, no. 1, pp. 1-23, July 1923.

Presents a law for the fall of a small spherical body through a gas at any pressure. Considers the theoretical derivation and experimental verification of the law. In this relation, the writer considers Stokes' law.

3. The electron. Ed. 2, 293 pp., illus. Chicago, Univ. Chicago Press, 1924.

Presents evidence of the atomic structure of electricity and describes properties of the electron. Gives a modified Stokes' law (p. 101).

MILLS, ANSON.

1. (and Follett, W. W.). Reports on the investigations and survey for an international dam and reservoir on the Rio Grande del Norte to preserve the boundary between the United States and Mexico by controlling the flood waters of Said River, with appendices A, B, and C. Internatl. Boundary Comm. U. S. and Mex., Proc., vol. 2, pp. 392-400, 1903.

Results of investigations relative to the selection of a dam site for the international dam and reservoir on the Rio Grande del Norte. Silt measurements by Major Mills in the vicinity of El Paso, Tex., indicate that a safe assumption of the life of the proposed reservoir would be 150 yr. W. W. Follett's calculations indicate a life span for the reservoir of less than 115 yr. Considers means of preventing and removing silt accumulations from the reservoir.

MILLS, W. H., JR.

1. Suggested method for mechanical analysis of soil by elutriation. In Amer. Soc. for Testing Mater., Procedures for testing soils, pp. 53-55. Philadelphia, 1944.

A method by elutriation for the determining of various sizes of different particles in all types of soils from topsoils and sandy-clay to sands and clays.

MILNE-THOMPSON, L. M.

1. The vector of the equations for the motion of a solid through a liquid. Internatl. Cong. Appl. Mech., Proc., (1938) 5, pp. 444-447, 1939.

Expresses, in vector form, equations for the movement of a solid through a liquid. Describes conditions to be satisfied at the boundary of the solid and gives an expression for the kinetic energy of the liquid in terms of vector integrals. Investigates the partial differential coefficients of kinetic energy with respect to a vector, and expresses in these terms and in terms of the impulse-wrench the equations of motion. Proof is given. Presents Kirchhoff's equation in vector form of the motion of a solid through a liquid. Translation is made to a body in a stream and to permanent rotation.

MILNER, HENRY BREWER. See also Raeburn, C., 1; Tyler, S. A., 2.

1. Sedimentary petrography. Ed. 3, 666 pp., illus. New York, Nordeman Pub. Co., Inc., 1940.

Comments on past work in sedimentary petrography. Discusses sampling, laboratory techniques, mechanical analysis, correlation of sediments, applied sedimentary petrology, identification of minerals, X-ray, fluorescence, and microchemical methods of mineral analysis.

MINAKER, W. L. See Johnson, J. W., 11.

MINER, J. H.

1. Reduction of seepage losses in a canal through porous shale. West. Engin., vol. 8, pp. 19-20, Jan. 1917.

Describes means of utilizing silt to reduce seepage losses in the main canal of the Grand Valley Project, Colo.

MINNAS-UD-DIN, K. B. SH. See also Anonymous, 92.

1. Silt distribution at bifurcations on canals. Indian Engin., vol. 85, pp. 52-55, illus., Jan. 26, 1929. Describes a method for the measurement of the relative silt-draw of canal offtakes to determine the effectiveness of silt preventing devices. Experiments on silt distribution are described.

MISER, HUGH D.

1. The San Juan Canyon, southeastern Utah. U. S. Geol. Survey, Water-Supply Paper 538, 80 pp., illus., 1924; [abstract], Engin. News-Rec., vol. 94, no. 15, p. 596, Apr. 19, 1925.

Describes the geography of the canyon, the regimen of San Juan River, the canyon fill along the stream, the springs of the canyon, tributary streams, and water supplies. Discusses the characteristics and mode of production and movement of the sand waves of the San Juan River; the character of floods in the canyon, silt in the stream, physical characteristics of silt, effect of silt on fish life, results of observations on silt content, canyon fill along the San Juan River, general features, sources, tributary contributory contributions of rock debris to the San Juan, character and means of transportation and deposition of canyon fill, and depth of canyon fill.

2. Erosion in San Juan Canyon, Utah. Geol. Soc. Amer. Bul., vol. 36, pp. 365-378, illus., June 30, 1925.

Presents results of an investigation in 1921 by the U. S. Geological Survey on conditions of erosion in the San Juan Canyon, Utah. Includes discussion on conditions of debris transportation and deposition by the San Juan River and its tributaries, quantity of debris transported by the stream, sand waves in the San Juan River, and the effect of proposed power and storage dams on the regimen of the stream.

3. Erosion in the San Juan Canyon, Utah [abstract]. Wash. Acad. Sci. Jour., vol. 17, no. 4, pp. 98-99, Feb. 19, 1927.

An address by author on erosion in the San Juan Canyon, Utah. Describes the geologic structure of the canyon. San Juan River is always muddy, actually a river of mud during flood stages when it sometimes carries three times as much silt as water. Peculiar sand waves form and travel upstream. Lack of data showing total load of sediment annually discharged into the Colorado by the San Juan, leaves the question of the length of life of proposed reservoirs on the San Juan and the Colorado Rivers unanswered.

MISSISSIPPI RIVER COMMISSION. See U. S. Mississippi River Commission.

MISSOURI RIVER COMMISSION. See U. S. Missouri River Commission.

MITCHELL, BILLY T. See also Coldwell, A. E., 1; Einstein, H. A., 11; Howard, C. S., 8.

1. (and Brown, Leslie A.). Influence of water quality on flocculation of suspended sediment. Fed. Inter-Agency Sedimentation Conf., Denver, 1947, Proc., pp. 246-257, illus., 1948.

Shows that the value of investigations into the physical and chemical nature of suspended sediment and the chemical quality of waters and sediment must be understood in order to obtain an adequate understanding of suspended sediment phenomena. Experiments are described and results given for influence of water quality on flocculation of suspended sediment. Indicates further research is needed before definite conclusions can be reached regarding the exact nature of flocculation.

MITCHELL, R. H.

1. (and Hall, Robert G.). Sedimentation in a small artificial lake. Science n. s., vol. 85, no. 2209, pp. 426-427, Apr. 30, 1937.

Reports the effect of sedimentation in reducing the storage capacity of a small artificial lake at Muskingum College, Ohio. Notes distribution of silt in the lake and formation of delta at mouth of incoming stream. Decrease of storage capacity of lake through silting amounted to 29 percent in 20 yr. Effect of gullying, sheet erosion, and building construction on deposition of sediment in lake is noted.

MITCHELL, W. S. See Ockerson, J. A., 4.

MITCHELSON, A. T.

1. Conservation of water through recharge of the underground supply. Civ. Engin., vol. 9, no. 3, pp. 163-165, illus., Mar. 1939.

Discusses the conservation of water through recharge of the underground supply in California. Includes two paragraphs noting that the requirements to recharge underground supplies

by spreading water from natural channels over porous lands are met on debris cones at the mouths of canyons. Notes problem of controlling water on cones because of their unstable state, due to storms bringing down varying amounts of silt, sand, gravel, and boulders, making diversion of flood water difficult.

MITRA, A. N.

1. Rivers in western Bengal and Orissa. Inst. Engin., Calcutta, Jour., vol. 10, pp. 155-187, illus., May 1931.

Gives general river conditions of western Bengal and Orissa in India. Comments on the utilization of silt in land development and agricultural deterioration due to the exclusion of river silt.

2. Training of rivers. Inst. Engin., Calcutta, Jour., vol. 24, no. 3, pp. 24-46, illus., Mar. 1944.

Discusses the construction of works to train rivers in order that they may be beneficial to man. Considers methods for use in the protection of banks. Treats of the use of silt in fertilizing land. Classifies methods of river training and suggests remedies to alleviate problems encountered in river training.

MOBERLY, C. H.

1. The River Volga. Engineering, vol. 64, no. 1647, pp. 102-103, July 23, 1897.

Gives a general description of the River Volga, Russia. Includes discussion on nature of river banks, formation of sand banks, silting at mouths of creeks, formation and occasional silting of pools, washing away of banks, channel shifting, and existence of wave-like undulations consisting of shallows and pools on river bottom. Discusses the movement of shallows on river bottom.

2. The River Volga. Engineering, vol. 64, no. 1652, pp. 248-249, Aug. 27, 1897.

Describes the Volga River, Russia, in its various reaches. Discusses length and width of reaches, tributaries, variations in water levels, volume of flow, and character of bed and banks. Notes means of removing shallows by dragging rakes along river bottom, permitting current to carry off stirred-up sand and states that channel shifting is due to accumulated sand deposits.

3. The River Volga. Engineering, vol. 64, no. 1654, pp. 309-310, illus., Sept. 10, 1897.

Describes the River Volga from Czaristsin to the Caspian Sea, Russia. Notes formation of sand banks by deposits from washed away banks, the effect of wind on water depth at the mouth of the Volga, channel changes, and advance of delta into sea at ratio of 1270 ft. per annum. Estimated quantity of deposits carried to sea during flood season is 35,000,000 cu. ft. of solid matter in 50 days.

4. The River Volga. Engineering, vol. 64, no. 1658, pp. 427-428, illus., Oct. 8, 1897.

An historical account of improvements to the River Volga, Russia. Summarizes data on fall of the river, surface velocity, water levels and tributary conditions. Describes improvement operations by dredging, use of reservoirs, confining current with guide shields or screens, and the use of dragging rakes to stir up sand to be carried off by the current. Includes cost figures.

5. The waterways of Russia. Engineering, vol. 67, no. 1726, pp. 99-100, illus., Jan. 27, 1899.

Describes the canals of Russia. Notes that the River Porosovitsa flows through light clayey sand which is easily stirred and moved by commotion in water, and that its banks cave in causing silting up of channel.

6. The waterways of Russia. Engineering, vol. 67, no. 1734, pp. 371-374, illus., Mar. 24, 1899.

Describes canals in Russia. Notes silting of Sias and Svir navigation canals in 1876, which necessitated constructing a second line of canals parallel to old ones. These subsequently silted also.

7. The waterways of Russia. Engineering, vol. 67, no. 1742, pp. 638-639, May 19, 1899.

In describing the canals of Russia states that the narrowing and silting up of Alexander I Canal by deposits and caving of banks reduced

water depth. Silting up of Catherine II Canal necessitated a parallel canal. Silting up of Peter I Canal caused measures to be taken to insure Alexander III and Maria Feodorovna Canals against silting and injury to slopes.

8. The waterways of Russia. Engineering, vol. 69, pp. 73-74, Jan. 19, 1900.

Describes the waterways of Russia and Finland. Gives features of river courses, noting transportation of sediment, and growth and advance of the deltas. Describes features of the Caspian Sea, noting rate of silting at outlets of silt-bearing streams during the last 60 yr. to be from 3 to 9 in. per yr.

MOCKMORE, C. A. See Rogers, H. S., 1.

MONISH, B. H. See Grover, N. C., 12.

MONTGOMERY, I. F.

1. Nature makes settings for Tacoma's low cost water power. Universal Engin., vol. 50, no. 5, pp. 19-23, illus., Nov. 1929.

Describes the engineering details of the Nisqually and Cushman power plants, Tacoma, Wash. Includes brief description of silt and debris control features of the Nisqually plant.

MONTGOMERY, JOSEF E. See Howard, G. W., 1.

MONTGOMERY, JULIAN. See Taylor, T. U., 6.

MONTGOMERY, P. H.

1. Erosion and related land use conditions on the Lloyd Shoals Reservoir watershed, Georgia. U. S. Soil Conserv. Serv., Erosion Survey, 10, 26 pp., illus., 1940.

Report of an erosion survey made by the U. S. Soil Conservation Service (1936 and 1937) on the Lloyd Shoals Reservoir watershed, Ga., to provide information to be correlated with results of a sedimentation survey, and which is to be used as a basis for land-use and erosion-control planning. Includes discussion on the relationship between sedimentation and soil erosion. Sedimentation survey (Feb. 4 to Apr. 13, 1935) revealed that the Lloyd Shoals Reservoir, a hydroelectric development on the Ocmulgee River, 8 miles east of Jackson, Ga., lost 12.40 percent of its original capacity in 24.3 yr., or 0.51 percent annually. The total accumulation of sediment amounted to 13,960 acre-feet, or 574 acre-feet per year. Calculations indicate that approximately 92,500 acre-feet of soil was eroded in the drainage basin during the 24.3 yr. Estimates that only 11 percent of the volume of soil lost (weight of soil in place estimated at 84 lb. per cu. ft.) accumulated in the reservoir, indicating other means of disposal of erosional debris. Presents data on the transportation of fine-grained sediment through the reservoir, deposition in upstream reservoirs and ponds, colluvial deposition at the base of slopes, and fluvial deposition in stream channels and on flood plains.

MOORE, BARRINGTON.

1. Checking floods in the French Alps. Amer. Forestry, vol. 16, no. 4, pp. 199-206, illus., Apr. 1910.
A brief account of damage caused by floods in the French Alps, the costly work being done to prevent future damages, and the importance of the conservation movement in the United States. Conditions of erosion and the transportation and deposition of erosional debris by streams of the French Alps are described.

MOORE, EMMELINE.

1. Stream pollution as it affects fish life. Sewage Works Jour., vol. 4, no. 1, pp. 159-165, Jan. 1932.
Deals with the effects of organic and inorganic pollutants derived from natural and industrial sources upon fish life in streams. Briefly considers the effect of silt pollution.
2. Barren hill slopes and their relation to fishing streams. N. Y. State Forestry Assoc., News Let., pp. 2-4, Dec. 1932.
Presents results of observations relative to the effects of accelerated erosion due to an insufficiency of vegetative cover on hill slopes upon plant and animal life in the streams of New York, in the Hudson and St. Lawrence River Basins.
3. The effect of silting on the productivity of waters. North Amer. Wild Life Conf., Trans. (n. s.), 2, pp. 658-661, 1937.

Discusses the deleterious effect of silt on fish life and on the productivity of natural and impounded waters. Results of biological studies in the Ashokan Reservoir, N. Y., to determine its capacity for producing a basic food supply for fish are given. Considers the factors which cause silting in the reservoir.

MOORE, H. F.

1. Oysters and methods of oyster culture. U. S. Fish Comm., Ann. Rpt., 1897, pt. 23, pp. 263-338, illus., 1898.

A technical report on oysters and method of oyster culture in the United States. Briefly notes effects of sediment on oyster development.

2. Report on the oyster beds of Louisiana. U. S. Fish Comm., Ann. Rpt., 1898, pt. 24, pp. 45-100, 1899.
A technical report on the oyster beds of Louisiana, 1897-98. Includes discussion on the influences of crevasses, with accompanied sediment deposition, upon the development of oysters.

3. Survey of oyster bottoms in Matagorda Bay, Texas. U. S. Bur. Fisheries, Doc. 610, 86 pp., illus., 1907.

Report of an investigation in 1904, on the biological and physical features of Matagorda Bay, Tex., with special reference to oyster production. Conditions of silt transportation and deposition in the bay and the effects of the action of storms, freshets, and silting on the oyster beds are considered.

MOORE, RAYMOND C.

1. Origin of inclosed meanders on streams of the Colorado Plateau. Jour. Geol., vol. 34, no. 1, pp. 29-57, illus., Jan./Feb. 1926.

Deals with the distribution, position, size, form, and topography of streams in relation to various governing geological factors, and describes the character and the origin of inclosed meanders in the Colorado Plateau. Considers volume of flow, gradient, stream load, and rock-hardness as factors in the development of inclosed meanders. Conditions favorable to the disappearance of meanders are discussed.

MOORE, WILLIS L.

1. A report on "The influence of forests on climate and on floods." 38 pp., illus., tables and graphs. Washington, Govt. Print. Off., 1910.

A report which argues against the creation of forest reservoirs. Presents facts and figures which are intended to show that forests do not control the flow of streams in high and low-water stages and that cutting away of forests does not affect the climate so materially as to increase droughts. Notes that floods are caused by excessive precipitation and are not of greater frequency or greater duration than formerly. Discussion: L. C. GLENN, (Amer. Forestry, vol. 16, no. 4, pp. 217-224, illus., Apr. 1910), in an article entitled Forests as Factors in Stream Flow, critically examines Moore's arguments against the creation of forest reserves. Results of observations relative to the effect of denudation upon flood production, soil erosion, stream and valley sedimentation, and alterations in the hydraulic regimen of streams in the southern Appalachians and in the Monongahela River basin are presented.

MORAN, RAYMOND F. See Weber, M., Jr., 1.

MOREHEAD, L. B.

1. Willow mats halt streambank erosion. Soil Conserv., vol. 5, no. 5, pp. 127-131, illus., Nov. 1939.

Describes a method of stream-bank protection by use of living willow mats developed by the Ohio Valley region of the U. S. Soil Conservation Service.

MORGAN, ARTHUR E.

1. (and McCrory, S. H.). Preliminary report upon the drainage of the lands overflowed by the north and middle forks of the Forked Dear River and the Rutherford Fork of the Obion River in Gibson County, Tennessee. Tenn. Geol. Survey Bul. 3, pp. 17-43, illus., 1910.

A report on the drainage of lands overflowed by tributaries of the Forked Dear and Obion Rivers in Gibson County, Tenn. Conditions of

soil erosion in the watershed of these streams causing the deposition of silt on bottom lands and in stream channels are briefly described. Discusses the importance of soil erosion control, and the prevention of silt deposits to the success of drainage systems. Methods of control are considered.

2. Soil erosion in the West. *Amer. Forests and Forest Life*, vol. 36, no. 4, pp. 205-206, Apr. 1930. Considers the problem of soil erosion in the West, its causes, and methods of control. The transportation of soil still continues in the semi-arid regions. Elephant Butte Reservoir received enough silt annually to cover 30 sq. miles 1 ft. deep. Other reservoirs have filled or are filling with silt. Overgrazing is main factor in starting erosion; cattle and wagon trails start gullies into which soil is washed during rainstorms and carried into rivers to be deposited as silt. Digging silt from reservoirs, streams or ditches is a temporary expedient. Renewal of vegetation, planting of tamarisk, and the construction of small check dams will control this evil at its source.

MORIN, A. H.

1. River training in Tanjore. *Indian Engin.*, vol. 37, pp. 286-287, illus., May 6, 1905. Discusses means employed in the Tanjore District by which the oscillation of rivers are kept within bounds and land reclaimed. Describes methods of planting up of bed and margin of streams at adequate points with "nanal" (*Ochlandra rheedii*) to check velocity of water and to induce accretions of silt; reinforcing nanal plantations with "silt fences;" using groynes to divert currents and to prevent bank erosion; and using "nanal" facines for the protection of earthen banks.

MORISON, G. W.

1. The Missouri River. *School Mines Quart.*, vol. 17, no. 1, pp. 1-19, illus., Nov. 1895. An address describing the hydraulic characteristics of the Missouri River. Considers the Missouri River a silt-bearer, and reports condition of sediment transportation and deposition in the stream. Discusses source of the Missouri River silt, floods, changes in the river caused by the action of silt, bank erosion and protection, and river improvements.

MORISON, M. A.

1. The effect of light on the settling of suspensions. *Roy. Soc. London, Proc., Ser. A, Math. and Phys. Sci.*, vol. 108, no. A746, pp. 280-284, June 2, 1925. Discusses the effect of light on the settling of suspensions in the course of experiments on an optical method of determining the size distribution of soil particles.

MORRIS, BROOKS T.

1. Scour-control and scour-resistant design for hydraulic structures. *Amer. Geophys. Union, Trans.*, vol. 23, pt. 1, pp. 60-67, illus., 1942. Presents the results of laboratory experiments which show that the addition of suspended load to a flow tends to reduce the apparent friction-factor and thus causes the flow velocity to increase. Analyzes the problem in terms of turbulent transfer mechanism and explains the action of the sediment in increasing the flow-velocity by its effect in reducing the turbulence. Presents evidence that action similar to those observed in water-flows carrying suspended loads are also found in other fluid-flows in which the density-gradient exists.

MORRIS, SAMUEL B.

1. Value of watershed cover in flood control. *Jour. Forestry*, vol. 33, no. 8, pp. 748-750, Aug. 1935. A paper presented at the annual meeting of the California Section of the Society of American Foresters, Dec. 7, 1934, on the value of watershed cover in flood control. Discusses the importance of watershed cover in preventing reservoir silting. Notes the effects of denudation due to burning of brush cover on watershed, and on the capacity of Gibraltar Reservoir which silted 28 percent in 13 yr. It is estimated that the reservoir will be completely silted up in 46 yr. States that the Colorado River transports annually 137,000 acre-feet of silt, and esti-

mates complete filling of Boulder Canyon Reservoir in 222 yr. Notes value of watershed cover in channel maintenance, and diminishing quantity of debris deposited on improved areas formerly natural desilting agencies.

2. Observed phenomena of silt-laden inflow to Morris Reservoir, California, in relation to thermal stratification. *Internat. Geod. and Geophys. Union, Minutes and Rpts.*, vol. 1, [4 pp.], Washington, D. C., Sept. 1939.

A report on the behavior of a muddy San Gabriel River freshet passing through the mountain reservoir created by Morris Dam. Describes Morris Dam and Morris Reservoir, meteorological conditions in watershed, and the normal variations in reservoir temperatures. Notes that in the late fall, when surface water temperature becomes less than that of lower water, the reservoir "turns over," and there is a complete commingling of the previous temperature stratified water, the water becoming all one temperature and highly turbid. A phenomenon of quantities of very muddy water entering the reservoir, flowing along the bottom and through the flood release outlets, occurred during April 1935. Inspection disclosed that the reservoir was "turning over" (as is usual in the fall) with a complete removal of thermal stratification and with high turbidity, explaining the phenomenon. Outlines the action of density current observed in the glass-sided model in the U. S. Soil Conservation Service Laboratory at the California Institute of Technology.

3. Colorado River, the Southwest's greatest natural resource. *Amer. Waterworks Assoc. Jour.*, vol. 39, no. 10, pp. 945-967, illus., Oct. 1947. Describes problems concerned with the Colorado River, noting history, development, the Colorado River Compact, the building of Hoover Dam, and the Mexican treaty. States that after 100 yr., silt will occupy a third of the storage capacity of Lake Mead. Points out that in 1928 the U. S. Department of Agriculture gave 138,000 acre-feet as the total annual silt load of the river at Yuma.

MORRISON, JOHN A. See Fry, A. S., 2.

MORSE, F. T.

1. A new form of river bank protection. *Railway Age*, vol. 66, no. 21, p. 1279, illus., May 25, 1910. Describes in detail the construction of steel jetties used for river bank protection on the Kansas River in the vicinity of Topeka, Kans.

MORSE, H. H.

1. Erosion and related land use conditions on the Muskingum River watershed. *U. S. Soil Conserv., Phys. Land Survey* 7, 36 pp., illus., 1939. Report of a survey which includes two paragraphs, noting that as a result of erosion of topsoil from land in Muskingum River watershed huge quantities of silt have been washed into the Muskingum River, and millions of dollars have been spent to dredge channels and to remove silt and debris from city property inundated by flood waters. Uncontrolled erosion on land above reservoirs can materially decrease their efficiency and decrease their life span due to silting.

MORSE, W. L. See Fristoe, R. E., 1.

MORTIMORE, M. E.

1. A double check on erosion. *Soil Conserv.*, vol. 7, no. 6, pp. 150-151, illus., Dec. 1941. Presents results of the application of parts of experimental techniques devised by the Sedimentation and Physical Surveys Division of the U. S. Soil Conservation Service relative to the estimation of the volume of soil losses and the degree of erosion in two portions of the Little Sioux River watershed in northeastern Iowa. Results of observations on volume of soil loss by sheet erosion and by gully and roadside erosion, and on the volume and distribution of modern deposit are given. Notes that these data are important in connection with planning conservation programs for flood control, and for the protection of reservoirs, stream channels, etc., against damages by sedimentation.

MORTINOV, P. F. See Archangelsky, B. V., 1.

MOSELEY, HARRY H. See Slade, J. J., 1.

MOSIER, J. G.

1. (and Gustafson, A. F.). Washing of soils and methods of prevention. Ill. Agr. Expt. Sta., Bul. 207, pp. 513-550, illus., Apr. 1918.
Presents data on the extent and nature of erosion in Illinois and describes means for its control. Includes brief data on organic matter, nitrogen, and phosphorous in the surface stratum of representative timber soils in the State, and of the bottom land receiving their wash.

MOSSERI, V. M.

1. Note in the Nile deposits in Egypt. Union des Agr. d'Egypte, Bul., vol. 17, no. 128, pp. 49-78, 1919; [abstract], Expt. Sta. Rec., vol. 42, no. 5, pp. 420-421, Apr. 1920.
Deals with the mechanical, physical, and chemical properties, and agricultural value of types of alluvial soil deposited by the Nile River.

MUCKEL, DEAN C. See American Society of Civil Engineers. Committee on Conservation of Water, 1.

MUCKLESTON, H. B. See Fortier, S., 2.

MUEHLEISEN, GOTTLIEB.

1. The porous dam method of erosion control. Agr. Engin., vol. 7, no. 10, pp. 350-351, illus., Oct. 1926.
An article on the use of porous dams to control erosion. Grids of wire mesh or steel bars are set up to intercept debris which will itself form a dam to impound flood waters and cause silt deposition behind a dam thus formed. Grids are spaced along stream with top of one at same elevation as bottom of the next one upstream. By varying grid spacing across stream, lateral control of deposition may be effected. By use of porous dams, a river is made to effect its own control.

2. Controlling moisture, erosion and flood water. Agr. Engin., vol. 13, no. 8, p. 308, illus., Aug. 1932.
Discusses the value of artificial ponds and dams for controlling erosion and keeping silt out of streams.

MUKERJEE, R. K.

1. Changes in Ganges basin. Water and Water Engin., vol. 37, no. 447, p. 233, Apr. 1935.
An abstract of an address entitled Agricultural Contrasts and Fluctuations in Northern India. Makes brief note to the effect of forest destruction in catchment areas of the Tributaries of the Ganges upon conditions of silting on river beds in low lands and to the effect of canalization in the United Provinces on silting up processes.

MULHOLLAND, R. A. See Camp, Thomas R., 2.

MÜLLER, ROBERT. See also Meyer-Peter, E., 2.

1. Ueberprüfung des Geschiebengesetzes und der Berechnungsmethode der Versuchsanstalt für Wasserbau an der E. T. H. mit Hilfe der direkten Geschiebemessungen am Rhein (Re-examination of the bed-load law and method of calculation of the Research Institute for Hydraulic Structures at the E. T. H. with the aid of direct bed-load measurements on the Rhine). Schweiz. Bauzeitung, vol. 110, no. 15, pp. 180-184, Oct. 9, 1937. In German. Translation on file at the U. S. Soil Conservation Service, Washington, D. C.; California Institute of Technology, Pasadena, Calif.; and the Hydraulic Research Center, U. S. Waterways Experiment Station, Vicksburg, Miss.

Discusses the re-examination of bed-load law and method of calculation by the Research Institute for Hydraulic Structures, Zurich. Direct bed-load measurements on the Rhine are used as an aid to the study. Gives a check-up on the law of tractive force and a method of calculation. States that computations are in close accord with actual data.

MULLIKEN, ROBERT S. See Tolman, R. C., 2.

MUNGER, HAROLD H. See Stevens, J. C., 6.

MUNNS, E. N.

1. The control of flood waters in southern California. Jour. Forestry, vol. 17, no. 4, pp. 423-429, illus., Apr. 1919.
Describes method of controlling floods, erosion, and the transportation and deposition of debris, by using a system of check dams in the Haines Canyon and Sunland Drainage Basin, Calif. Destructive effects of storms and floods of 1914, 1915 and 1916, are described. Discusses effectiveness of check dams.

2. Chaparral cover, run-off, and erosion. Jour. Forestry, vol. 18, no. 8, pp. 806-814, Dec. 1920.

Describes the erosion of soils in the drainage basin areas of rivers originating in the San Gabriel Mountains prior to, or after, the fires of the Angeles Forest in 1919. Notes that the peak of high water, containing large quantities of silt, came sooner from denuded areas than from areas with chaparral cover. Discounts belief that impregnation of irrigation water with potash and other salts from the burned areas must be injurious to agricultural lands. Describes the complete, and partial filling with silt of "check dams" in the denuded Little Dalton Canyon. Estimates, following examination, that all but 3.5 percent of annual brush cover will sprout after fires. Mentions new gully formations during the storms following these fires. Notes that daily samples of San Gabriel River water collected at flood heights in the Dalton Canyon after light storms, in March 1920, show a soil content as high as 90 percent by volume.

3. (and others). Watershed and related forest influences. 73d Cong., 1st sess., S. Doc. 12, vol. 1, pp. 299-461, 1933.

W. R. Chapline, R. D. Forbes, L. F. Kellogg, and H. G. Meginnis, joint authors.
In this report on stream flow and erosion problems of national importance, the aid of forest cover in solving these problems is considered. Describes watershed protection of forests in other countries, and gives classification of watershed protection influence of forests in the United States. Discusses climate and physiography, watershed and streamflow problems, urban water supplies, water power, navigation, erosion, floods, sedimentation, forests of watersheds, land use and other data on major drainage basins of the United States.

4. (and Sims, Ivan H.). Forests in flood control. Supplemental report to the Committee on flood control, House of Representatives, Seventy-fourth Congress, second session, on H. R. 12517 to provide for a permanent system of flood control, and for other purposes. 70 pp., illus. Washington, 1936.

Deals with the various aspects of forests in relation to flood control, and includes discussion on the relation of erosion to flood-control structures. Notes condition of sedimentation in many of the minor tributaries of the Yazoo River in northern Mississippi, and condition of reservoir silting in the southern Piedmont. Discusses the factors affecting the rates of reservoir silting, and the rates of silting in reservoirs at Spartanburg, S. C., High Point, N. C., Rogers, Tex., and in the Elephant Butte, Zuni, Roosevelt, Elk City, Old Lake Austin, and Waco Reservoirs. Cites instances of accelerated erosion due to denudation in the Challis National Forest in 1932.

5. Sedimentation problems of the land. Fed. Inter-Agency Sedimentation Conf., Denver, 1947, Proc., pp. 29-34, 1948.

Reports the various problems caused by sedimentation, and gives a general over-all picture of the widespread threat of sedimentation. Relates various problems and damages caused by sedimentation.

Discussion: JOHN N. SPENCER, pp. 34-35, mentions the problem of water use and proposes that steps be taken to protect the resources of land and water. HAROLD B. ELMENDORF, pp. 35-36, describes sediment problems in the Rio Grande. RANBIR SINGH SHRIKANT, pp. 36-37, mentions some of the problems of sediment and irrigation in India.

MÜNTZ, A.

1. (and Lainé, E.). Les matériaux charriés par les cours d'eau des Alpes et des Pyrénées (The material carried by the streams of the Alps and Pyrenees). Paris Acad. des Sci., Compt. Rend., vol. 156, no. 11, pp. 848-851, 1913; [abstract], Expt. Sta. Rec., vol. 33, no. 8, p. 718, Dec. 1915.
Treats of studies of silt carried by streams and silt transportation capacities of streams in the Alps and Pyrenees to determine the possi-

- bilities of silting in canals and reservoirs. Results show that the Alps carry more silt and dissolved matter than the Pyrenees.
2. (and Lainé, E.). Etudes sur la formation des limons et leur charriage par les cours d'eau dans les Alpes et les Pyrénées (Studies on the formation of silt and its transportation by streams in the Alps and Pyrenees). Paris Acad. des Sci., Compt. Rend., vol. 160, no. 15, pp. 462-467, 1915; [abstract], Expt. Sta. Rec., vol. 33, p. 719, Dec. 1915. Points out that quantities of soluble and suspended matter varied according to the geologic formations from which they derived. Notes that erosion is greater in the Alps than in the Pyrenees. Points out the close relation of the physical composition of suspended and deposited silt to the velocity of the stream.
 3. (and Lainé, E.). Etudes sur la valeur agricole des limons charriés par les cours d'eau des Alpes et des Pyrénées (Studies on the agricultural value of the silts transported by the streams of the Alps and Pyrenees Mountains). Paris Acad. des Sci., Compt. Rend., vol. 160, no. 16, pp. 491-495, 1915; [abstract], Expt. Sta. Rec., vol. 34, no. 6, pp. 512-513, Apr. 1916. Gives data on the agricultural value of silts transported by streams of the Alps and Pyrenees Mountains; notes influence of silt deposits upon the chemical and mechanical character of soils.
- MURATA, K. J.
1. Exchangeable manganese in river and ocean muds. Amer. Jour. Sci., vol. 237, no. 10, pp. 725-735, illus., Oct. 1939. A paper on a study of exchangeable manganese in river and ocean muds. Discusses the action of exchange of cations in river muds on entering the sea, noting the occurrence of exchangeable manganese. Describes materials and analytical methods employed to determine the total and exchangeable manganese of river and ocean muds. Notes source, physical characteristics, and reaction to hydrogen peroxide of mud samples. Presents results of analyses noting specifically the relative total manganese content of the samples, the order of magnitude of the dissolved manganese concentrations in equilibrium with river mud, and the average exchangeable manganese content of river muds. Discusses the variations in the amount of the coexistent total and exchangeable manganese in muds, and factors affecting such changes. Includes appendix discussing the solubilities of manganese minerals in ammonium acetate.
- MURPHY, E. C. See also Clapp, W. B., 1.
1. Destructive floods in the United States in 1903. U. S. Geol. Survey, Water-Supply Paper 96, 81 pp., illus., 1904. Presents various data on floods and flood damages during 1903 in the United States. Includes three paragraphs noting conditions of erosion and deposition caused by floods of the Kansas and Republican Rivers.
 2. Changes in bed and discharge capacity of the Colorado River at Yuma, Ariz. Engin. News, vol. 60, no. 13, pp. 344-345, illus., Sept. 24, 1908. Presents results of an investigation relative to the discharge capacity of the Colorado River at Yuma, Ariz., and the corresponding scour or fill of bed for the period 1903-1907.
 3. The influence of sand of one size on the quantity of sand of another size that a stream will transport. Cornell Civ. Engin., vol. 18, pp. 251-253, illus., 1910. Presents results of experiments to determine the influence of one size of sand on the capacity of a stream to transport another size.
 4. The behavior of a stream carrying sand and the effect of sand on the measurement of bottom velocity. Engin. News, vol. 63, no. 20, pp. 580-581, illus., May 19, 1910. Reports changes in the appearance of a stream of water as sand is fed into it in increasing amounts and the nature of sand movement which gives rise to these changes. Gives results of observations made in the Hydraulic Laboratory of U. S. Geological Survey, of a wooden trough 2 ft. in width with discharge from 0.1 to 0.75 sec. ft. Several sizes of debris used. Concludes that if channel bed is even, water surface will be comparatively smooth until stream becomes almost fully loaded. As overload takes place the slope increases and is accompanied by striking changes in water surface appearance.
 5. Water power in southwestern United States. Jour. Elect., vol. 39, no. 12, pp. 549-550, illus., Dec. 15, 1917. Presents brief data on the available power in the southwest and notes the possibilities for further development. States that the estimated volume of silt when consolidated in the bottom of the proposed San Carlos Reservoir will average 4,500 acre-feet annually. Report that the capacity of Santa Fe Reservoir, on Santa Fe Creek, N. Mex., was reduced 40 percent by debris carried down by one flood.
- MURPHY, HENRY F. See Harper, H. J., 1.
- MURRAY, EVERETT B.
1. Flood protection at Kansas City. Engin. News, vol. 68, no. 26, pp. 1194-1197, illus., Dec. 26, 1912. Describes flood protection works on the Kaw River at Kansas City, Kans. Outlines construction of levees, revetment construction to protect slope of embankment from cutting by water and water-borne debris and the removal of obstructions.
- MURRAY, HAROLD W. See Fry, A. S., 2.
- MUSGRAVE, G. W.
1. Some relationships between slope-length, surface-runoff, and the silt-load of surface runoff. Amer. Geophys. Union, Trans., vol. 16, pt. 2, pp. 472-478, tables, graphs, Aug. 1935. Discusses the phases of slope-length as it affects surface-runoff and silt-load. Data show that the assumption that percentage of runoff and total erosion are greater on long than short slopes is not applicable to all conditions. Gives methods and results of study. Calls attention to the importance of the relation existing between rainfall-intensity and infiltration-capacity in determining relative soil and water movement from agricultural lands.
 2. The quantitative evaluation of factors in water erosion—A first approximation. Jour. Soil and Water Conserv., vol. 2, no. 3, pp. 133-138, July 1947. Gives the results of findings of a group of workers which show the relationship between the major causal factors and the resulting rate of erosion. Notes qualitatively, the primary factors influencing the rate of erosion, such as rainfall, flow characteristics, soil characteristics, and vegetal cover. Deals with a quantitative evaluation of these major causal factors and gives data on soil losses on different soils at erosion experiment stations with adjustments to common rainfall and degree and length of slope. Method can be used to extend findings from the localized areas shown in the report to large numbers of similar soils in other parts of the country in order to obtain an objective analysis of the erosion problem.
- NADER, JOHN.
1. Improvement of the mouth of the Mississippi River. Wis. Acad. Sci., Arts, Letters, Trans., vol. 3, pt. 1, pp. 84-95, 1875. Deals with the improvement of the mouth of the Mississippi River for navigation purposes. Considers the physical and hydrological conditions of the stream, transportation and deposition of alluvium, composition of the delta, amount of alluvium deposited annually in the Gulf, outward growth of delta, etc. Difficulties to be overcome in improving the mouth of the Mississippi are discussed. Considers various plans for improvement and states that the proposed Fort St. Philip Canal plan is most reliable.
- NAGLE, J. C.
1. Progress report on silt measurements. U. S. Off. Expt. Sta. Bul. 104, pp. 293-324, illus., 1902. Reports silt observations on the Brazos River, west of College Station and on the Wichita River at Wichita Falls, Tex. Describes Brazos and Wichita River basins and methods of sampling and equipment. Gives discharges (Brazos and Wichita Rivers), silt determinations (Brazos,

Wichita, Rio Grande, Laramie and Salt Rivers), and percentage of silt at varying depths (Brazos, Wichita and Pecos Rivers). The estimated average is 1.28 percent of the silt carried by the Brazos River, 1.17 percent by the Wichita and 0.345 percent by the Rio Grande. After samples were allowed to stand for 1 yr. the estimated average was reduced to 0.96 percent and 0.9 percent for the Brazos and Wichita Rivers respectively. Gives chemical analyses of sediment in Brazos, Wichita, and Rio Grande Rivers and analyses of water in Brazos, Wichita, Salt and Laramie Rivers; rate of silting and distribution of silt in Austin Reservoir on the Colorado River at Austin, Tex., and in Lake Avalon and Lake McMillan on the Pecos River near Carlsbad, N. Mex. Describes methods employed in dealing with silt in canals on the Platte River, Nebr. and suggests methods of dealing with silt in the proposed reservoir on the Wichita River above Wichita Falls and in the projected Elephant Butte Reservoir at Elephant Butte, N. Mex.

2. Second progress report on silt measurements. U. S. Off. Expt. Sta. Bul. 119, pp. 365-392, 1902.

Presents general results of discharge, runoff, and silt measurements made on the Brazos River, Brazos County, Tex., between November 1900 and February 1902 and gives results of observations with reference to the percentage of silt at varying depths at stations and estimated total silt carried by the Brazos, Wichita, and Rio Grande Rivers. Compares sediment determinations by volume and by weight.

3. The silt problem in connection with irrigation storage reservoirs. Tex. Acad. Sci., Proc. and Trans., vol. 4, pt. 2, no. 3, pp. 1-14, 1900-03.

A paper read at the Waco meeting of the Texas Academy of Science, Dec. 29, 1901, giving results of investigations in connection with the siltage of irrigation, storage reservoirs on streams in Texas and New Mexico and discusses volumetric methods of sediment analysis, method of sampling, and sampling apparatus. Observations were conducted on Brazos River at Jones Bridge, on Wichita River at Wichita Falls, on Pecos River, and Rio Grande at El Paso to determine distribution of silt in cross-section, percentages of silt transported, and the effect of flood on sediment content of stream. Effects of silt on impounding reservoirs is discussed giving results of discharge measurements and silt determinations for Brazos and Wichita and Rio Grande Rivers, effects of reservoirs on deposits above dam, life of proposed reservoir on Rio Grande at El Paso estimated at 150 yr. Characteristics of compacted silt in reservoirs are examined noting conditions at Austin Dam. Outlines briefly conditions necessary for the extension of the life of reservoirs. Present data regarding silt removal from existing reservoirs in Spain and New Mexico. Chemical contents of Brazos River water are noted.

4. Third progress report on discharge and silt measurements on Texas streams. U. S. Off. Expt. Sta. Bul. 133, pp. 196-217, illus., 1903.

Summarizes results of investigations of discharge and silt measurements made on the Brazos River at Jones Bridge during 1902, silt determinations for the Rio Grande at El Paso, Tex., between February 1901 and June 1902, and for the Colorado River at Wharton, Tex., June 1-Sept. 2, 1902. Comparison of silt determinations by volume and by weight is given.

NAKAYAMA, H.

1. Some model investigations about the motion of sand along a self-formed channel. Tokyo Imp. Univ. Faculty, Engin. Jour., vol. 13, pp. 193-253, illus., Jan. 1923.

Deals with model experiments to determine, for a portion of a self-formed channel, the change of form of cross-sections, the variation in slope of water surface, the volume of sand carried along the watercourse, and the relation between surface slope at, and volume of sand carried through, a given point in the watercourse. Describes method of experimentation and gives detailed data on results.

NANDI, S. C.

1. Note on model experiments to ascertain the effect of raising and widening the bed of the Tribeni Canal over Naraingarh Aqueduct. Indian Engin., vol. 92, no. 15, pp. 292-294, illus., Oct. 1932.

An article describing model experiments to determine the effect of raising and widening the bed of the Tribeni Canal over Naraingarh Aqueduct, India. Observations relative to flow, silting, scour, afflux, eddy motion, and loss of head are discussed and conclusions given.

NAPPER, CHARLES W.

1. Flood erosion along Paint Creek, Fayette County, Ohio. Ohio Nat., vol. 14, no. 4, pp. 252-255, illus., Feb. 1914.

Describes a cut made by the Paint Creek just below the Iron Bridge, 2 miles above Greenfield, Ohio, during the flood of March 1913. The re-deposited drift material spreads to a thickness of 3 ft. over heavily sodded pasture. Also describes conditions of erosion and deposition.

NATIONAL RESEARCH COUNCIL, INTERDIVISIONAL COMMITTEE ON DENSITY CURRENTS. SUBCOMMITTEE ON LAKE MEAD.

1. Lake Mead density currents investigations, 1937-1940. Vol. 1, illus., tables and graphs. Denver, Colo., U. S. Bur. Reclam., 1941.

Gives results of investigations on density currents in Lake Mead on the Colorado River. Sketches briefly the early history, program, methods, equipment, and progress made as reported to the Subcommittee. Gives data that have been analyzed in innumerable different ways. Observations include discharge conditions, concentration and composition of dissolved matter, and quantity of suspended matter carried by the Colorado River. Mechanical analyses of suspended matter are included. Considers bed-load determinations.

2. Lake Mead density currents investigations, 1937-1940. Vol. 2, illus., tables and graphs. Denver, Colo., U. S. Bur. Reclam., 1941.

This report is a continuation of Vol. 1 of data collected in density-current investigations in Lake Mead on the Colorado River. Gives data on suspended load, dissolved load, conductance, water surface elevations, etc. Mechanical analyses of suspended load are given.

3. Lake Mead density currents investigations, 1940-1946. Vol. 3, tables and graphs. Denver, Colo., U. S. Bur. Reclam., 1947.

Continues data collected in the investigation of density currents in Lake Mead on the Colorado River. Gives data on discharge, temperature, conductance, suspended load, mechanical analyses of suspended matter, water surface elevations, etc.

NATIONAL RESOURCES PLANNING BOARD. See U. S.

National Resources Planning Board.

NAVY DEPT. See U. S. Navy Dept.

NEBRASKA STATE PLANNING BOARD.

1. Blue River basin. In Nebr. State Planning Bd. Water resources of Nebr.; prelim. rpt., pp. 619-669. Lincoln, 1936.

Deals with existing conditions of and proposed improvements to irrigation, flood control and water-power developments of the Blue River basin, Nebr. Notes briefly conditions of sedimentation in the basin.

2. Elkhorn River basin. In Nebr. State Planning Bd., Water resources of Nebr.; prelim. rpt., pp. 427-468. Lincoln, 1936.

Deals with existing conditions of and proposed improvements to irrigation, flood control and water-power developments in the Elkhorn River basin, Nebr. Notes briefly conditions of erosion and sedimentation in the basin. The Elkhorn River contributed 22.2 percent of suspended matter carried by the Platte River and the average concentration of sediment in the Elkhorn was 3,920 p.p.m.

3. Loup River basin. In Nebr. State Planning Bd., Water resources of Nebr.; prelim. rpt., pp. 327-425, illus. Lincoln, 1936.

Deals with existing conditions of and proposed improvements to irrigation and water-power developments of the Loup River basin, Nebr. Conditions of erosion and sedimentation in the basin are briefly described. Notes that Loup

River contributes 48 percent of the total sediment transported by the Platte River; average suspended sediment concentration in the Loup River is 31,110 p.p.m.

4. Niobrara River basin. In Nebr. State Planning Bd., Water resources of Nebr.; prelim. rpt., pp. 275-326, illus. Lincoln, 1936.
Deals with existing conditions of and proposed improvements to navigation, irrigation, flood control, and power developments of the Niobrara River basin, Nebr. Brief data are given on conditions of erosion and on the nature, character, and amount of sediment transported in the basin.
5. Platte River basin. In Nebr. State Planning Bd., Water resources of Nebr.; prelim. rpt., pp. 1-211, illus. Lincoln, 1936.
Deals with existing conditions of and proposed improvements to water supply, irrigation, flood control, and water-power developments in the Platte River basin, Nebr. Notes briefly that silt deposits have reduced the capacity of Guernsey Reservoir (completed in 1927) from 72,700 acre-feet to 60,000 acre-feet and estimates further reduction due to silt encroachments to about 25,000 acre-feet in 15 yr.
6. Republican River basin. In Nebr. State Planning Bd., Water resources of Nebr.; prelim. rpt., pp. 495-617, illus. Lincoln, 1936.
Deals with existing conditions of and proposed improvements to irrigation, flood control, and power developments in the Republican River basin, Nebr. Brief data are given on conditions of erosion in the basin and on the character and amount of sediment transported by the stream.
7. White River basin. In Nebr. State Planning Bd., Water resources of Nebr.; prelim. rpt., pp. 239-273, illus. Lincoln, 1936.
Deals with existing conditions of and proposed improvements to flood control, irrigation, and power developments in the White River basin, Nebr. Briefly notes that the large amount of suspended sediment carried by the stream is chiefly the result of a high average rate of erosion over the entire drainage area.

NEEDHAM, JAMES G.

1. Between the hills and the sea. Amer. Forests, vol. 39, no. 5, pp. 198-199, illus., May 1933.
Pertains to erosion and sedimentation in Georgia and Florida swamps and describes the shoaling process of the lower channel of the Apalachicola River which caused the formation of the Chipola River cut-off and the deposition of silt in the Chipola channel and lowlands resulting in the damming up of waters of that river and the formation of "dead lakes."

NEFF, DANIEL R.

1. Development and maintenance of a navigable channel in the Missouri River. Civ. Engin., vol. 10, no. 9, pp. 579-582, illus., Sept. 1940.
Describes the work of the Missouri River improvement project. Gives an account of cut-off construction, trends toward lighter structures, the development of asphalt revetments, and rock and earth-fill chute closure dams.

NELSON, GEORGE A. See Tiffany, J. B., Jr., 1.

NELSON, MARTIN E. See also Howard, C. S., 8; U. S. Interdepartmental Committee, 10.

1. Field conferences on suspended sediment sampling. 48 pp. St. Paul, Minn., U. S. Engin. Off., 1944.
Discusses matters of interest, observations, and discussions presented at field conferences held intermittently beginning in Omaha on May 9 and 10 and ending in Kansas City on Aug. 3, 1944. Comments centered around field tests on the U. S. Sediment Samplers D-43 and P-43 and various comparisons which were made; apparatus, technique and laboratory procedures were reviewed. The conferences considered the local sediment problems and purposes of sediment-sampling programs, and reviewed the basic principles of sediment sampling which are related to the design of present samplers and the ideas of improving the present design of samplers.
2. (and Benedict, Paul C.). Study of methods used in measurement and analysis of sediment loads in streams. 22 pp. St. Paul, Minn., U. S. Engin. Off., 1946.

This paper, presented at the American Society of Engineers Convention, Spokane, Wash., July 1944 is a compilation of significant facts and information dealing with sediment sampling which are considered pertinent to the interests of the American Society of Civil Engineers Joint Committee on Sedimentation in Reservoirs. Treats such subjects as history of sediment sampling, theory of sediment suspension, methods of making sediment measurements, suspended sediment samplers, development of US integrating suspended samplers, field tests on suspended sediment samplers, laboratory analysis of sediment samples, and future program of sediment investigations.

NELSON, WESLEY R.

1. Silt despoiler of the soil. Reclam. Era, vol. 34, no. 3, pp. 43-45, illus., Mar. 1948.
Comments on the tremendous soil losses caused by uncontrolled water and the effects of silt deposition in the backwater area above a reservoir pool. Treats the effects of silt on plants and animals and deals with the problem of siltation in reservoirs and the prevention of silting. Outlines briefly general methods of upstream sediment control, such as use of sediment-detention structures, afforestation and forest management, regrassing and grassland management, cultivation practices, water spreading, stream-bank protection, and protected channelways and gully control.

NEMENYI, PAUL. See also Kalinske, A. A., 2; Vanoni, V. A., 4.

1. Movement of bed load. In his Wasserbauliche Strömungslehre; Handbuch der physikalischen und technischen Mechanik (The science of hydraulic flow; handbook of physical and technical mechanics) vol. 5, 1931. In German. Translation on file at the U. S. Soil Conservation Service, Washington, D. C., and the University of California, Berkeley, Calif.

Deals with the problem of bed-load movement. Considers shearing force. Comments on work of men such as Leppik, Jakuschoff, Ehrenberger, Donat, Kalitin, Schoklitsch, Kramer, etc. Gives various equations concerned with the problem.

2. The different approaches to the study of propulsion of granular materials and the value of their coordination. Amer. Geophys. Union, Trans., vol. 21, pp. 633-647, illus., July 1940.

Shows that the comparative or unified study of all phenomena related to the study of propulsion of granular material can contribute to the creation of better quantitative methods in each particular field. The phenomena of flow around a smooth sphere are analyzed. The basic mechanisms responsible for the origination, transformation, and migration of rhythmic phenomena connected with propulsion of granular materials are discussed. Considers grain-study and turbulence-research as fundamentals of this problem. The search for general and specific variables governing the process of sediment propulsion is considered and dynamic test cases are cited. Treats of the vortex mechanism, mechanism of low-angle grain-bombardment, sand waves, antidunes, Austausch-function, etc. Includes a bibliography of 74 articles dealing with the problem.

NENOWN, JOHN S. See Kalinske, A. A., 2.

NESPER, FELIX.

1. Ergebnisse der Messungen über die Geschiebe und Schlammführung des Rheines an der Brugger Rheinbrücke (Results of bed load and silt movement observations on the Rhine at Brugg Bridge). Schweiz. Bauzeitung, vol. 110, no. 12-13, pp. 143-148, 161-164, Sept. 18-25, 1937. In German. Translation on file at the Hydraulic Research Center, U. S. Waterways Experiment Station, Vicksburg, Miss.

Deals with measurement of bed load and suspended load in the Rhine at Brugg Bridge. Describes methods and procedure used. Considers grain size of bed load in the study of bed-load movement.

NETZER, BENNIE N. See Kalinske, A. A., 2.

NEUMAN, DAVID L. See Howard, G. W., 1.

NEVIN, C. M.

1. (and Trainer, D. M., Jr.). Laboratory study in delta building. *Geol. Soc. Amer. Bul.*, vol. 38, pp. 451-458, illus., Sept. 30, 1927.

Describes results of a model study which illustrate conditions of transportation and deposition of debris in connection with delta building.

NEVIN, CHARLES.

1. Competency of moving water to transport debris. *Geol. Soc. Amer. Bul.*, vol. 57, pp. 651-674, illus., July 1946.

Gives a definition of competence as related to moving water and considers briefly misconceptions regarding the transporting power of currents. Presents data on the competency of currents to support debris in suspension, and outlines a new traction-tube method for studying transportation along a stream bed. Notes that data from traction-tube experiments when compared with flume experiments are found to be integrated. Suggests some tentative applications of laboratory data to sedimentation. Includes suspension and traction curves which show the relation of grain sizes to the velocities of currents that support debris in suspension and that carry debris by traction along the bed.

NEW HAMPSHIRE FLOOD RECONSTRUCTION COUNCIL.

1. Report...on the flood of March, 1936. 80 pp., illus. [Concord], 1936.

Deals with the flood of 1936 on the Connecticut and Merrimack Rivers in New Hampshire. Presents nature and causes, emergency action taken, flood damage to industries, farms, and public property, Federal aid, and flood control planning and mobilization for future disasters. Discusses the extent of land damage due to the erosive action of the flood and to sediment deposition. Gives character of the deposited material.

NEW SOUTH WALES. WATER CONSERVATION AND IRRIGATION COMMISSION.

1. Report...for the year ended 30th June 1914. 188 pp. Sydney, 1914.

Report of the Chief Engineer (pp. 21-36) on progress of engineering work at Burrinjuck Dam and Reservoir including data on measurement of silt in stored waters (July 1910-June 1912).

2. Report...for the year ended 30th June 1915. 109 pp. Sydney, 1915.

Includes (pp. 39-42) the report of the resident engineer at Burrinjuck Dam on the progress of engineering work at the dam and reservoir. Includes tabular data on the measurement of silt in stored waters (1910-15).

3. Report...for the year ended 30th June 1916. 128 pp. Sydney, 1916.

Reports (pp. 101-104) on progress of engineering work at Burrinjuck Dam, N. S. W., including data on silt deposits in the reservoir (1910-16).

4. Report...for the year ended 30th June 1917. 74 pp. Sydney, 1918.

Reports (pp. 42-44) on the progress of engineering work at Burrinjuck Dam, including data on silt measurements in Burrinjuck Dam, for 1911-17, and on silt deposits for the year ending June 20, 1917.

5. Report...for the year ended 30th June 1919. 34 pp. Sydney, 1919.

Describes (pp. 8-21) progress of operations on irrigation areas in N. S. W. established and controlled by the State. Notes briefly results of measurements of siltation at Burrinjuck.

NEW YORK (CITY). BUREAU OF WATER SUPPLY.

1. Report...1926. N. Y. City Dept. Water Supply, Gas and Elect., Ann. Rpt. for 1925-26-27, pp. 177-237, 1928.

Notes effect of the storm of Nov. 15-16, 1926, in the Schoharie and Esopus watersheds on the turbidity of the surface waters in the respective basins. States that the turbid water had evidently passed under the clear water in the Ashoken Reservoir.

NEW YORK (STATE). DIVISION OF STATE PLANNING.

1. A preliminary survey of the water resources of New York; the Black River. N. Y. Div. State Planning, Bul. 30, 49 pp., illus., Mar. 1938.

Presents results of a survey for the proposed development of the Black River, N. Y. Notes the extent of and possible remedial measures to control soil erosion and silting in the river basin. In a brief note on the silting of reservoirs in the Adirondack region, states that these reservoirs may be expected to have indefinitely long life spans.

NEWBERRY, J. S.

1. Report upon the Colorado River of the west—geological report. 36th Cong., 1st sess., S. Ex. Doc., pt. 3, 154 pp., illus., 1861.

Discusses the general geology of the area bordering the lower Colorado. Comments on arroyos, transport and deposition of sediment by the Colorado River.

NEWELL, FREDERICK HAYNES.

1. Hydrography of the arid regions. U. S. Geol. Survey, Ann. Rpt. (1890-91) 12, pt. 2, pp. 219-361, illus., 1891.

Presents results of studies dealing with the hydrography of the arid regions of the United States. Gives brief data on silt observations at Embudo, N. Mex., from Jan. 14 to Apr. 15, 1889.

2. Report of progress of the division of hydrography of the calendar year 1895. U. S. Geol. Survey, Bul. 140, 356 pp., 1896.

Gives brief data on condition of Potomac River water and weight of sediment (Oct. 1891-Jan. 1892), changes in the channel of the Chama River due to the flood of August 1895, the design of irrigation ditches in the Rio Grande Valley noting in particular the factors conducive to silt deposition in the Algodones Ditch, the means employed to prevent silting in the Valera Ditch, and the results of a silt survey at the LaGrange Reservoir site, Tuolumne River.

3. Report of progress of stream measurements for the calendar year 1899. U. S. Geol. Survey, Ann. Rpt. (1899-1900) 21, pt. 4, pp. 9-488, illus., 1901.

Presents brief data on conditions of erosion and deposition in canals and ditches on reservations of the Uncompahgre Indians (Duchesne River) and the White River Indians (Uinta River). Discusses the silt problem of the Gila River, notes that the stream carries an average of about 2 percent of solid matter in suspension, the mean annual solids carried past San Carlos is estimated at 8,443 acre-feet (Lippincott) and at this estimated rate of deposit the proposed San Carlos dam would fill in 63 yr., the possible means of prolonging the life span of the reservoir are briefly described.

4. Forests and reservoirs [extract]. Forester, vol. 7, no. 9, pp. 225, Sept. 1901.

Extract from a technical paper read at a meeting of the American Forestry Association, Denver, Colo., Aug. 27-29, 1901. Discusses briefly the importance of the perpetuation of forest cover upon the catchment area of a reservoir in keeping silt and sediment from diminishing its storage capacity.

5. First annual report of the Reclamation Service from June 17 to Dec. 1, 1902. 57th Cong., 2d sess., H. Doc. 79, 317 pp., illus., 1903.

The first annual report of the U. S. Reclamation Service shows work done and in progress. Discusses public arid lands and the history of the national irrigation movement and laws dealing with irrigation. Notes conditions of work of reclamation in various States and Territories. Gives plans for combating silt and cleaning San Carlos Reservoir by sluicing. An annual inflow of 8,000 acre-feet of solid matter is indicated by observations at the San Carlos Reservoir. Includes suspended-load data on sediment observations of Salt River below Tonto Creek, Livingstone, Ariz., for 1901 and 1902; percentages of silt by volume and weight are given for the Colorado River at Yuma, Ariz., Jan. 10, 1900-Jan. 19, 1901.

6. Prospect for irrigation along the Colorado River. Forestry and Irrig., vol. 9, no. 2, pp. 72-74, Feb. 1903.

Deals with the possibilities for irrigation along the lower Colorado River and notes briefly the problem of silt control.

7. Second annual report of the Reclamation Service, 1902-03. 58th Cong., 2d sess., H. Doc. 44, 550 pp., illus., 1904.

The second annual report of the U. S. Reclamation Service deals with the work done and in progress, and gives general aspects of irrigation and reclamation. Sets forth progress made in surveys and examinations and in constructing works of reclamation. Includes data on silt carried by the Colorado River, February-June 1903, and Jan. 10, 1900-Jan. 19, 1901; notes fertilizing value of silt. Treats of the method of prevention of silting in the Hondo Reservoir.

8. Third annual report of the Reclamation Service, 1903-04. 58th Cong., 3d sess., H. Doc. 28, 653 pp., illus., 1905.

Describes work of the U. S. Reclamation Service for 1904. Gives a general discussion of the reclamation law and general questions of policy. Discusses a silt survey of the Pecos River and gives data on sedimentation in Lake McMillan. Gives data on percentage of silt in the waters of the Rio Grande at El Paso, Tex., for various periods during 1897, 1898, 1900, 1902, and 1903. Includes data on sedimentation in the proposed reservoirs at El Paso, Tex., and Engle, N. Mex., January 1897-June 1904. Treats briefly of the sluicing of sediment from these reservoirs.

9. [Review of] Egyptian irrigation, by W. Wilcocks and J. I. Craig. Engin. News, vol. 72, no. 3, pp. 162-163, July 16, 1914.

Review of book entitled Egyptian Irrigation (Wilcocks, W., 4). Compares irrigation problems in United States and Egypt. Notes problems of storing and diverting Nile River water so that ample silt-laden water will come to fields depositing red mud of high fertilizing value, and to provide for rapid escape of waters. Storing Nile water deprives soil of fertilizing silt, swamps land, and causes accumulation of alkali.

10. Maintenance of irrigation systems. West. Engin., vol. 6, pp. 147, 151, Oct. 1915.

Discusses various means of repairing and cleaning, protecting slopes and banks, and clearing aquatic vegetation from irrigation canals and laterals.

NEWELL, R. J.

1. Sand trap helps to clear canal of sand and silt. Reclam. Era, vol. 15, no. 9, p. 147, illus., Sept. 1924.

Describes a desilting basin constructed in the feeder from the Wilson drain of the Boise project between the Caldwell and Notus Canals which serves the first division of the Black Canyon lands. The basin is of concrete 28 ft. by 40 ft., depressed 8 ft. below canal grade with a 6 ft. by 6 ft. concrete culvert controlled by a 6 ft. by 11 ft. 4 in. radial gate at one end. Skimming weirs on the canal inlets are set at 2 ft. above canal grade. The basin and adjacent feeder collects about 250 cu. yd. in 2 wk., which must be sluiced through the culvert. Sluicing requires 2 1/2 acre-feet of water for about 20 min. once every 2 wk. Previous to the construction of the basin, Notus Canal had to be cleaned twice during a year to maintain flow.

2. Sand trap prevents silting of canal. Engin. and Contract., vol. 62, no. 4, Water Supply, pp. 810-811, illus., Oct. 8, 1924.

Describes the design, cost, and operation of the sand trap at the entrance of the Notus Canal, Boise Project, Idaho, in order to prevent the silting of the canal.

NEWHALL, JAMES R. See Lewis, A., 1.

NEWHOUSE, F. See Senour, C., 2.

NEWHOUSE, FREDERICK.

1. Preservation of the Nile. Engineer [London], vol. 164, no. 4273, pp. 624-625, Dec. 3, 1937.

Describes the effects in Egypt of the future settlement and development of the Blue Nile watershed in Abyssinia which is far more dangerous than to have Lake Tsana in the watershed in hostile hands. Denudation by goats, etc. will double the total runoff of the Blue Nile causing overwhelming disaster in the lower

reaches. Includes economic effects of increased silting of reservoirs pointing out that at the present rate it will take centuries for reservoirs to silt while increased runoff may cause destruction in a few years.

2. The Nile flood. Engineer [London], vol. 166, no. 4314, pp. 304-305, Sept. 16, 1938.

Describes dangers caused by a high flood of the Nile River and measures that can be taken to prevent damage. Includes brief discussion on the use of reservoirs for holding excess flood waters, and the reservoir silting problem involved is noted.

3. Soil erosion—II. Engineer [London], vol. 166, no. 4322, pp. 522-523, Nov. 11, 1938.

Considers in detail what the fatal sequence "denudation, erosion, and desiccation" does today, what the engineer and agriculturalist can do to prevent their doing harm, and what part they may have played in past civilizations. In this connection discusses The Wilderness of Zin, by C. L. Woolley and T. E. Lawrence, and The Pulse of Asia, by E. Huntington, which describes the effects of erosion, stream and valley sedimentation, and the silting up of reservoirs upon the ancient civilizations in Sinai and Central Asia.

NEWTON, DOROTHY A. See Bond, W. N., 1.
NEWTON, SIR ISAAC.

1. Sir Isaac Newton's mathematical principles of natural philosophy and his system of the world, translated into English by Andrew Motte in 1729. The translation revised, and supplied with an historical and explanatory appendix, by Florian Cajori. 680 pp., illus. Berkeley, Calif., Univ. Calif. Press, 1934.

Consists of a revision of Motte's translation of Newton's *Principia*. Treats of such subjects as laws of motions, the motion of falling bodies, the motion of falling bodies in resisting mediums, and the system of the world in mathematical treatment. States that when a body falls in a non-viscous medium, the fall is proportional to the square of the velocity of the body.

NICCOLI, VITTORIO.

1. Miglioramenti fondiari (Land improvement works). 479 pp., illus. Turin, Italy, Unione Tipografico-Editrice Torinese, 1923. In Italian. Translation on file at the U. S. Soil Conservation Service, Washington, D. C.

A book on land improvement works. Under Pt. 3, Extraordinary Land Improvement Works, are described methods of reclamation by drainage and by building up land with sediment and by drainage. Presents historical data on land building by silting in Italy. Presents data on factors involved in the transportation and deposition of sediment transported by water. Describes methods of land building by deposition of sediment from silt-laden streams. Includes considerable design data for construction of embankments, spillways, basins, etc., for effecting deposition of sediment.

NICHOLS, GEORGE.

1. The vegetation of Connecticut—V. Plant societies along rivers and streams. Torrey Bot. Club. Bul., vol. 43, no. 5, pp. 235-264, illus., May 1916.

Concerns vegetation in rock ravines and in ravines located in unconsolidated rock, bearing of pre-erosion topography on the phenomena of succession in rock ravines, vegetation along river and stream bluffs, and the succession of plant association resulting from topographic changes occurring during flood-plain development along the Connecticut River. Discusses flood-plain associations along the Connecticut River and phases of flood-plain growth. Describes the growth of an island which has been developed entirely within the last 30 yr. at Windsor, Conn. The rich alluvial soil on higher flood-plains supplies the most fertile land in the State. In the development of flood-plain vegetation from the hydrophytic to the mesophytic, the final formation of a mesophytic forest may be of a temporary nature due to the lateral swinging of streams with its accompanying erosion and deposition. When down cutting by age-old streams occurs, flood plains become terraces and new flood plains may be formed at lower levels.

NICHOLS, J. BURTON. See also Svedberg, T., 1.

1. (and Liebe, Henriette C.). The centrifugal method for the determination of the distribution of size of particle of suspended matter. Colloid Symposium Monog., vol. 3, pp. 268-284, illus., June 1925. Discusses the theory of the centrifugal method for the determination of distribution of size of particle. Obtains an approximate relation between mass mean radius and obscuring power.

NICHOLS, KENNETH D. See also Vogel, H. D., 8.

1. Observed effects of geometric distortion in hydraulic models. Amer. Soc. Civ. Engin., Trans., vol. 104, pp. 1488-1509, illus., 1939.

Defines geometric distortion on models as "a systematic change from geometric similitude involving the use of exaggerated depths or slopes." The advantages, disadvantages, and limitations of distortion in models are discussed, noting factors determining the degree of distortion. Procedure in hydraulic model studies is outlined and discussed. Studies of 14 specific models are analyzed for effects of geometric distortion on change in form of cross-section of channels and of the structures. Hydraulic capacity of an open channel, changes in characteristics of flow and nature of cross-currents, excessive scour, improper location of scour, and side slope instability are discussed. Studies analyzed show effects on bed formations of variations in bed materials, and in slope and depth distortions. Summarizes studies of flood control and river navigation in the Mississippi River system. Conclusions and recommendations regarding use, design, and operation of distorted models are given. Bibliography is included.

Discussion: HERBERT W. EHRGOTT, pp. 1510-1515, presents data on observed values of Manning's roughness coefficient n for small models employing various cross-sections and bed materials. Discusses applicability of Nichol's formulas of distortion with reference to equations of "compatibility" among laws of hydrotechnics. Examines effects of changes in characteristics of bed material on distortion, effect on submerged works, and action on sharp bends. E. H. TAYLOR, pp. 1515-1517, describes model tests at the University of California to determine the effects of geometric distortion upon bed configuration of a moveable bed model. Notes effect of turbulence upon laws of similarity. HERBERT D. VOGEL, pp. 1517-1520, notes the use of smaller rivers as models of larger prototypes wherein exaggerations of hydraulic factors are effected by nature (Mississippi and Elbe Rivers). Discusses establishment of ultimate permissible limits of distortion. The economic problems involved in the degree of distortion of various elements in model are noted. THE AUTHOR, pp. 1520-1521, considers the applicability and limitations of equations in the design of moveable bed models and the problems of comparison between distorted and undistorted models.

NICHOLSON, J. H.

1. Erosion control in the Tennessee Valley. Agr. Engin., vol. 17, no. 12, pp. 509-510, illus., Dec. 1936.

An article on erosion control methods in the Tennessee Valley. Work started in 1933 to protect Norris Lake from silt, but was extended in 1935 to the entire valley. Gullies under 5 ft. are controlled by planting, those over 5 ft. by brush and wire dams. The planting is locust and pine. Permanent structures are preferred to terracing. Sod strips and concrete ditch checks are used to control erosion of shallow ditches.

2. (and Snyder, John E.). Manual for soil erosion control in the Tennessee Valley. I. Engineering phase, revised, October 15, 1939. 128 pp., illus. [Knoxville, Tenn.], Watershed Protect. Div., Dept. Forestry Relat., U. S. Tenn. Val. Authority, [1939].

A manual devoted to methods and techniques of erosion control engineering. Contains information gathered from experiences and observations of the authors in supervising engineering phases of erosion control works of 38 TVA-CCC Camps. Describes various types of erosion control and preventative methods.

NICKLE, HARRY G. See Stevens, J. C., 2.

NIEHAUS, E. J. See Hodge, W. W., 1.

NIELSEN, C. J.

1. Construction of the Alamogordo. Reclam. Era, vol. 28, no. 6, pp. 112-115, illus., June 1938.

Presents an account of the construction of the Alamogordo Dam, Pecos River, N. Mex. Includes notes on loss of storage capacity by silting in the McMillan Reservoir on the Pecos River near Carlsbad.

NIELSEN, NIELS. See Dryden, L., 4.

NIESSEN, K. F. See Verwey, E. J. W., 1.

NIKOLITCH, MILAN.

1. Two large irrigation projects in Russia. 2. Engin. News, vol. 74, no. 3, pp. 102-104, illus., July 15, 1915.

Describes the construction of two large irrigation projects in Russia and discusses topography of southeastern Caucasia. The Kura and Arrax Rivers carry large amounts of suspended matter which are deposited at the mouth of the Kura River or spread over areas of the steppe during high water. The Arrax River carries 1.12 percent of silt by weight in spring and about 0.3 percent by weight in winter. Notes value of silt as fertilizer, the amount of dissolved salts in the Arrax River during the spring (21.74 pt. per 100,000), and describes the former and present irrigation and bank protection works.

NIVEN, WILLIAM W.

1. Improved method of soil study. Engin. News-Rec., vol. 120, no. 14, pp. 515-516, Apr. 7, 1938.

Describes an improved apparatus for determining particle-size distribution of a soil. Stokes' law is used to determine the sizes of particles settling in the time intervals used in the test. The advantage of this method lies in the reduction of disturbance of the soil particles during sedimentation. This method, after more extensive use and further investigation, may prove to be more precise than standard methods now used.

NOBLE, ALFRED. See Coppee, H. St. L., 1.

NOBLE, C. C. See Podufaly, E. T., 1.

NOETZLI, F. A. See LaRue, E. C., 2.

NOLAN, THOMAS RICHARD.

1. Slips and washouts on the hill section of the Assam-Bengal Railway. Inst. Civ. Engin., Minutes of Proc., vol. 218, pp. 2-26, illus., 1923.

Discusses slips and washouts on the section of the Assam-Bengal Railway from Chittagong to Bhojo, 1904-23. Contains a discussion on the erosion of the river bank in the Jatuga and Mahur Valleys, where the railway hugs the bank closely. Also gives an account of measures of prevention.

NOLL, JOHN J.

1. Erosion damage to river and harbor works. Soil and Water Conserv. Jour., vol. 4, no. 2, pp. 83-84, illus., Apr. 1949.

Discusses soil erosion damages and costs of dredging of the southeastern rivers and harbors. Notes dredging at Savannah Harbor, and points out that sedimentation surveys of the southeastern reservoirs show an average rate of sediment production of about 1/2 acre-foot of sediment produced annually per square mile of drainage area. A survey of Lake Issaqueena, S. C. showed that the watershed produced 2.19 acre-feet of sediment annually per square mile of drainage area.

NOLLA, J. A. B.

1. (and Crawford, G. L.). La conservacion del suelo en Puerto Rico (Soil conservation in Puerto Rico). 30 pp., illus. Washington, U. S. Soil Conserv. Serv., 1941. In Spanish. Translation (pp. 12-13) on file at the U. S. Soil Conservation Service, Washington, D. C.

Discusses the factors affecting and the effects of accelerated erosion in Puerto Rico and outlines a coordinated plan of soil conservation for the island. Includes a brief discussion of the effects of accelerated erosion upon conditions of reservoir silting. Data are given on rates of silting in the Guayabal, Coamo, Carite, Patillas, and Comerio Reservoirs.

NORTON, J. H.

1. Quantity and composition of drainage water and a comparison of temperature, evaporation, and rainfall. *Amer. Chem. Soc. Jour.*, vol. 30, no. 7, pp. 1186-1190, July 1908.

Presents results of experiments conducted during 1906 to determine the quantity and quality of waters of Richland Creek, Madison and Washington Counties, Ark. Data are given on stream flow, hydrology of watershed, and results of dissolved- and suspended-load determination of samples of stream waters. Estimates that drainage waters remove 0.000313 in. of soil annually from the watershed. The extent of soil elements removed annually is noted.

NUTTING, P. G.

1. The stratified settling of fine sediments. *Wash. Acad. Sci. Jour.*, vol. 19, no. 18, pp. 402-406, Nov. 4, 1929.

Presents a simple and general theory on the stratified settling of fine sediments. The theory considers, as a factor in stratified settling, the upward diffusion due to the Brownian movement.

OAKES, HARVEY.

1. Erosion and related land use conditions on the Lake Crook watershed, Lamar County, Texas. U. S. Soil Conserv. Serv., Erosion Survey 14, 23 pp., illus., 1940.

Presents results of a soil conservation survey of Lake Crook watershed made early in 1937 to furnish data regarding the character of the watershed, which can be correlated with sedimentation studies of Lake Crook and Lake Gibbons made Feb. 27-Mar. 31, 1936. A description of the area and methods and results of the conservation survey are given, including climate, vegetation, economic and cultural development, agriculture, soils, erosion, relation of erosion to land-use, and relation of erosion to soil and slope. The sedimentation survey revealed that silt deposits have reduced the capacity of Lake Crook by 6.37 percent in 13 yr. and that of the smaller Lake Gibbons only 5.52 percent in 36 yr., these differences in rates are largely the result of differences in the character of the two reservoirs and their watersheds. Estimates of erosional debris removal and of alluvial and colluvial accumulations in the watersheds of the two reservoirs are given. Also discusses the significance of physical factors in the control of soil erosion.

OAKS, ROBERT M.

1. (and Knapp, Robert T.). A "closed-circuit" flume of suspended-load studies. *Amer. Geophys. Union Trans.*, vol. 17, pt. 2, pp. 525-528, illus., July 1936.

- Describes the design of a "closed circuit" flume for studies by the Cooperative Laboratory of the U. S. Soil Conservation Service to determine the influence of suspended load on the flow characteristics of streams.

O'BRIEN, JOHN T. See Senour, C., 3.

O'BRIEN, MORROUGH P. See also Grover, N. C., 12; Howard, G. W., 1; Kramer, H., 2; Stevens, J. C., 2; Vogel, H. D., 9.

1. Review of the theory of turbulent flow and its relation to sediment-transportation. *Amer. Geophys. Union Trans.*, vol. 14, pp. 487-491, Apr. 1933.

Reviews the theory of turbulent flow developed by Osborne-Reynolds, Prandtl, von Karman, and Taylor, and its application to the distribution of suspended material by Schmidt and others. Notes that in flowing streams the percentage of suspended material decreases with the distance above the bed and with certain depth and average velocity, particles above a critical size or specific gravity are not put into suspension. As the random velocities which make up turbulent flow also provide the means for carrying particles into the interior of the fluid, a quantitative theory of turbulence should provide a theory for distribution of material in suspension. Discusses shearing force and mechanical viscosity over a cylindrical surface and the application to steady flow of water in open channels, shearing force on the area parallel to the bottom of the channel as related to the transfer of momentum across area, and

distribution of suspended material. Conclusions note the possibility of checking the theory of turbulent flow by simultaneous measurements of sediment-distribution and average velocity at each depth and practical application of the theory in computing the total volume of sediment carried in suspension. The theory gives information regarding percentages of sediment as close to bed as velocity measurements can be carried.

2. (and Rindlaub, B. D.). The transportation of bed-load by streams. *Amer. Geophys. Union Trans.*, vol. 15, pt. 2, pp. 593-603, illus., June 1934.

Gives the result of a critical survey of available data to ascertain whether or not a quantitative prediction of bed movement is possible. Discusses experimental results of relationship between tractive force and bed movement, of relationship between friction-factor and size of material, and on critical tractive force. Defines bed load and discusses rate and nature of bed movement in natural channels. States in conclusion that no equation for critical force or rate of bed movement is reliable for use in design. Measurements in natural channels are necessary and observations should be accompanied by laboratory experiments. Present status of bed-load problem is analogous to the situation in design of concrete structures in which numerous tests are made to determine strength. Notes that hydraulic resistance and velocity of fall may provide a basis for correlation of data on bed movement.

3. Models of estuaries. *Amer. Geophys. Union Trans.*, vol. 16, pt. 2, pp. 485-492, Aug. 1935.

Describes the construction of and laws applicable to small-scale hydraulic models for the study of tidal effects and sedimentation in estuaries. Outlines program of experiments under way at the U. S. Tidal Model Laboratory at the University of California.

4. Notes on the transportation of silt by streams. *Amer. Geophys. Union Trans.*, vol. 17, pt. 2, pp. 431-436, illus., July 1936.

Discusses various problems involved in the interpretation of theoretical and experimental results of studies on the transportation of bed load and suspended material by flowing water. Gilbert's theory of silt transportation and the theory of turbulent flow as developed by von Karman, Prandtl, and G. I. Taylor are treated. Considers the basic equations involved in the energetics of silt transportation, the use of tractive force as a basis for correlation of data on rate of bed-load movement, the determination of velocity gradient necessary to generalize data on the transportation of solids both as bed load and in suspension, the assumption that tractive force is a controlling factor in commencing bed movement, the rate of bed movement, the dissipation of energy in turbulent flow, and the vertical distribution of sediment resulting from haphazard transfers of fluid in the turbulent core of the stream.

5. (and Folsom, Richard G.). The transportation of sand in pipe lines. *Calif. Univ. Pubs. in Engin.*, vol. 3, no. 7, pp. 343-384, 1937; [abstract], *Engineering*, vol. 146, no. 3786, pp. 158-159, Aug. 5, 1938.

Deals with experiments on the movement of quartz sand and water through horizontal pipe lines. Considers the suspension of small solid particles in a liquid subjected to flow conditions which are well into the regime of turbulent flow where the flow is little affected by the apparent viscosity. Comments on such subjects as viscosity, turbulent flow, settling velocity, centrifugal pumps for sand-water mixtures, and gives conclusions.

OCKERSON, J. A. See also Allison, J. C., 3; Beach, L. H., 1; Curd, W. C., 1; Grunsky, C. E., 1; McMath, R. E., 5.

1. Erosion of river banks on the Mississippi and Missouri Rivers. *Amer. Soc. Civ. Engin., Trans.*, vol. 28, pp. 396-424, June 1893.

Deals with erosion of river banks of the Mississippi and the Missouri Rivers. Banks of sand, silt and clay when saturated at high water cave during falling stage of water. Total volume

erosion per mile on the Mississippi is 972,092 cu. ft. Total solid matter in suspension passing New Orleans is about 1/3 total amount of erosion. Average annual rate of caving per mile of Missouri River banks is 62,339 sq. yd. Tables are given.

Discussion: WILLIAM STARLING, (Amer. Soc. Civ. Engin., Trans., vol. 31, pp. 1-4, Jan. 1894), describes the formation of the alluvial basin of lower Mississippi River, and confirms Ockerson's conclusion that lateral oscillation of stream is confined to narrow limits. Discusses bank caving at various water levels. ARTHUR HILDER, pp. 4-12, notes that lateral oscillation of thalweg of Mississippi River is confined to narrow limits, yet, final improvement resolves itself into giving permanency and stability to banks and confining active forces of river to bed of stream. Discusses further surveys on bank erosion noting that where caving is most active in a bend, a large sand bar is formed on opposite side of river. Causes of bank caving and bank revetment are given. SAMUEL H. YONGE, pp. 12-14, notes that 702,670,000 cu. yd. of material is annually washed into the Missouri River from caving banks. The total quantity of material washed into the Missouri River is far greater due to amount of material added by its tributaries. Sediment observations on the Missouri River at St. Charles, Mo. in 1879, shows that total volume of sediment carried in suspension was 188,900,000 cu. yd. The same volume passed Columbus, Ky. in the Mississippi River 3 days later. Estimates that 1,727,500,000 cu. yd. of suspended material is contributed annually by the Missouri and the Mississippi Rivers between the mouth of Missouri and Cairo. Sediment observed passing New Orleans probably represents not more than 16 percent of whole volume of erosion. Gives estimate of total volume of erosion. Estimated total volume of material "pushed" into Gulf is 750,000,000 cu. yd. (Humphreys and Abbot). HENRY B. RICHARDSON, pp. 14-20, describes right and left bank erosion on Mississippi River, action of the river in forming cut-offs, and the effect of levees, character of banks, slope, and sloughing on bank erosion. Value of levee construction noted. HORACE M. MARSHALL, pp. 20-24, notes effect of slope and character of banks, stream velocity, drainage, and water levels on bank erosion. Describes extent of bank erosion on the Mississippi and the Missouri Rivers. Author's theory on bank caving and scour is given. W. P. CRAIGHILL, pp. 24-26, states that methods proposed by Ockerson for improvement of the Mississippi and the Missouri Rivers are special cases and not necessarily applicable to other streams. A. F. WROTNOWSKI, p. 26, notes the importance of considering slope of stream as a factor causing bank abrasions. Value of bank protection and contracting works noted. THE AUTHOR, pp. 26-28, comments on discussions presented on bank erosion along the Mississippi River and notes that the supposition, that slope of stream determines velocity of current, is erroneous.

2. Erosion of the Mississippi River banks [abstract]. Sci. Amer. Sup., vol. 36, no. 933, p. 14918, Nov. 18, 1893.

Abstract of a paper in which detailed data are presented with reference to bank erosion along the Mississippi River.

3. The Mississippi River navigation improvement [letter to editor]. Engin. News, vol. 35, no. 10, pp. 154-155, Mar. 5, 1896.
Describes the improvements to the Mississippi River accomplished by the Mississippi River Commission to aid navigation and prevent floods. Notes in one paragraph the effectiveness of works to protect banks by induced silting, revetment work, and construction of levees.
4. Dredges and dredging on the Mississippi River. Amer. Soc. Civ. Engin., Trans., vol. 40, pp. 215-310, illus., July 1898; also in Amer. Soc. Civ. Engin., Proc., vol. 24, no. 6, pp. 431-524, illus., June 1898; [abstract], Engin. Rec., vol. 38, no. 8, pp. 163-164, illus., July 23, 1898.

Deals with the maintenance and control of the Mississippi River. Describes, for each of the river's four reaches, the physical characteristics of the stream, high and low water conditions, extent of bank erosion and protection works, slope, volume of sediment transportation, discharge, floods, sand bar occurrences, and action of the stream at bends. Conditions of the transportation and deposition of sediment in the river are considered. Describes various types of dredges, river-improvement machines, jetty deflectors, and dredging operations, including costs.

Discussion: B. L. CROSBY, p. 311, notes that use of deflectors results in deposition below the deflector thereby transferring trouble to a point further downstream, as evidenced by deposition below an anchored barge. EDWARD FLAD, pp. 311-313, agrees that the water-jet agitator is a better machine than the mechanical agitator and makes comments on both agitators.

B. M. HARROD, pp. 314-316, states that improved dredging methods are the only solution to keeping the Mississippi River navigable. Notes that the method of stirring sediment into suspension is ineffective and river improvements with spurs and dikes are doubtful.

L. J. LE CONTE, pp. 316-318, notes that channel improvement by dredging should follow along the lines of natural erosion. Discusses applicability of scrapers, temporary wing dams and tree dams in river improvement, and hydraulic dredging problems. W. W. WHEELER, pp. 318-320, gives results of experiments on the application of the transporting power of water to the deepening and improvement of river channels. Describes a mechanical eroder, suitable for smaller rivers, and its operation. Suggests the use of suction dredges, cutters, and hoppers for improvement of the Mississippi and other large rivers. W. S. MITCHELL, pp. 321-324, comments on the effects of jetties on channel improvement. Describes several types of dredges. H. ST. L. COPPEE, pp. 324-329, speaks of the social and economic improvements arising from river regulation by dredging. Describes briefly the history of dredging in various parts of the world, noting in particular the advance of dredging machinery and operations in the United States. A. F. WOOLLEY, pp. 329-339, describes obstacles to maintaining navigation on the Old River, citing the action of the current which causes shoaling, the presence of the large sand bar annually formed at the junction with the Mississippi River, and sloughing banks. Outlines details of dredging operations of the "Ram" used on the upper Old River to remove the deposit of soft mud. L. M. HAUPT, pp. 340-345, briefly notes that the bed of the Mississippi River is rising due to sediment deposition. Comments on Ockerson's proposed use of current deflectors to induce sediment deposition, and cites evidence noting the opposite results from current action due to vertical deflection. Presents extracts from his own paper describing other regulating devices. Dredging and contraction works in river improvement are considered. A. W. ROBINSON, pp. 345-348, comments on the use of various types of dredging equipment. THE AUTHOR, pp. 348-354, illustrates further the effect of retarding influences on sediment deposition. Describes results of tests with dredges as a means of improving low-water navigation.

5. The improvement of the lower Mississippi River [extracts]. Engin. News, vol. 46, no. 12, pp. 186-187, Sept. 19, 1901; Engineering, vol. 72, no. 1863, pp. 381-382, Sept. 13, 1901.
Extracts from a paper read before the International Engineering Congress at Glasgow. Notes formation of sand bars by deposition of sediment derived from erosion of alluvial banks. Caving of banks of the Mississippi River below the Ohio River amounts to 1,003,579 cu. yd. for each mile of river per year. Describes the control of the lower river by revetment and contraction works and levee construction.

OCKERSON, J. A. - Continued

6. Flood control on the Mississippi River. Amer. Soc. Civ. Engin., Trans., vol. 85, pp. 1461-1481, illus., 1922.

Discusses the problem of flood control by the Mississippi River Commission. Describes the use of revetments for bank protection; deals with willow mattresses, articulated concrete mats, and solid concrete mats.

ODÉN, SVEN. See also Coutts, J. R. H., 1; Fisher, R. A., 1.

1. On clays as disperse systems. Faraday Soc., Trans., vol. 17, pt. 2, no. 50, pp. 327-348, illus., Feb. 1922.

Treats such subjects pertaining to clays as definition, characterization of clays by means of distribution curves, and calculation of distribution curve from the accumulation curve. Treats of the method of experiment.

2. The size distribution of particles in soils and the experimental methods of obtaining them. Soil Sci., vol. 19, no. 1, pp. 1-35, illus., Jan. 1925.

Comments on the Maxwellian concept of the distribution according to size and on obtaining a characteristic curve by plotting as abscissae some quantity related to size against some quantity related to the amount corresponding to every size. A special method of "sedimentation-analysis" has been developed from this concept; the writer develops a general theory for this method. Reviews practical methods developed up to 1924. Describes methods used by the writer as demonstrated at the Fourth International Congress of Pedology at Rome. Includes a mathematical discussion of methods for the determination of the distribution curve.

3. On the size of the particles in deep-sea deposits. Roy. Soc. Edinb., Proc. (1915-16), vol. 36, pp. 219-236, illus., 1937.

An investigation which develops a new method for the mechanical analysis of soils and deposits. The method consists of weighing from time to time on a balance, the sediment which accumulated on a circular disc suspended from the balance near the bottom of a vessel which has a suspension of the sample in water. Treats mathematically the fall of small particles through a column of liquid. Gives a mathematical analysis of the accumulation curve. Introduces the concept of the effective radius or the radius of a sphere that would settle in the fluid at the same rate as the given particle. Develops an accumulation-curve and with mathematical operations a distribution-curve is found. This method is applied to the study of some deep-sea deposits from the Challenger Office.

ODOM, LEO M. See Salisbury, E. F., 1; Whipple, W., Jr., 1.

OEXLE.

1. Raumgewicht der Schwemmstoffe (schlamm) (Volumetric weight of suspended material (sediment)). Wasserkr. u. Wasserwirtsch., vol. 29, no. 6, pp. 61-69, Mar. 16, 1934. In German. Translation by H. B. Edwards, Engineer Department Research Centers, U. S. Waterways Experiment Station, Vicksburg, Miss., on file there and at U. S. Soil Conservation Service, Washington, D. C.

Presents results of investigations relative to the volume-weight relations of suspended sediment. Numerous data concerning volumetric weight of suspended material, ascertained by other investigators, are given. Weights per unit volume and proportions of various grain sizes of 25 natural depositions of sediment are given. Data presented indicate the effects upon volumetric weight of deposition period, thickness of deposit, grain size, and rate of water movement. Results of laboratory determinations are given and discussed.

OFFICE OF LAND USE COORDINATION. See U. S. Office of Land Use Coordination.

OKAZAKI, B.

1. Concrete mattress bank protection. Engin. News, vol. 67, no. 20, pp. 922-924, illus., May 16, 1912. Describes a type of reinforced-concrete mattress for river bank protection. Results of tests on Yubari River (Japan) show that the mattress

is economical, durable, flexible and especially applicable on banks where caving is most severe. Gives description of mattress and method of setting.

OKEY, CHARLES W. See Senour, C., 2.

OLCOTT, GEORGE WHEELER. See Crane, J. L., Jr., 1.

OLIVE, W. T. See Buckley, A. B., 1.

OLIVECRONA, G. W.

1. The flood problem of Kwangtung. Assoc. Chinese and Amer. Engin. Jour., vol. 8, no. 10, pp. 5-17, Oct. 1927; [abstract], Engin. News-Rec., vol. 99, no. 22, pp. 875-876, Dec. 1, 1927.

Deals with various aspects of the flood problem of Kwangtung, China. Includes discussion on the growth of the vast Canton Delta resulting in the silting of river beds further upstream, and the confinement within dikes of the Kwangtung rivers. Comments upon afforestation, use of outlets, reservoirs, or cut-offs, dredging of streams, or other stream corrective works as a means of lowering floods and reducing conditions of sedimentation in streams. Notes problems involved and states that an effective system of dikes would give the protection needed against inundation, decrease silting, and lower the river bottoms by scouring.

OLMSTEAD, F. H. See also Woolsey, T. S., Jr., 1.

1. Gila River flood control. 65th Cong., 3d sess., S. Doc. 436, 94 pp., illus., 1919.

Presents results of investigations of practical methods of flood control on the Gila River, Ariz. Includes data on European methods of bank protection, details of construction, cost of Gila River bank protection works, and observations on the silt content of the Gila River (October 1916).

OLMSTEAD, L. B. See also Campbell, F. B., 1.

1. (and Alexander, Lyle T., and Middleton, H. E.). A pipette method of mechanical analysis based on improved dispersion procedure. U. S. Dept. Agr., Tech. Bul. 170, 22 pp., illus., Jan. 1930.

Is an investigation of methods of obtaining dispersion of soil material, especially the effect of the acid treatment and use of alkaline dispersing agents. Outlines a method of mechanical analysis based on the most satisfactory method of dispersion investigated and used by the U. S. Bureau of Chemistry and Soils.

2. (and Alexander, L. T., and Lakin, H. W.). The determination of clay and colloids in soils by means of a specific gravity balance. Amer. Soil Survey Assoc. Bul. 12, pp. 161-166, Mar. 1931.

Discusses the use of a specific gravity balance in the determination of clay and colloids in soils. Notes that the method needs further work on it so as to place it on a scientific basis.

3. Dispersion of soils by a supersonic method. Amer. Soil Survey Assoc. Bul. 12, pp. 167-168, Mar. 1931.

Deals with the use of high-frequency, high-intensity sound waves in soil suspension in order to disperse colloids. Advantages are that the results are quickly and easily obtained. A maximum sample of 50 gm. is used.

4. Dispersion of soils by a supersonic method. Jour. Agr. Res., vol. 42, no. 12, pp. 841-852, illus., June 15, 1931.

Describes apparatus and procedure for a supersonic method for the dispersion of soils. The amount of colloidal material extracted from soils is about the same as can be secured by the rubbing method, and is slightly greater than can be obtained from analyses by the pipette method.

O'NEILL, J. PAT.

1. Designs for suspended-load samplers based upon an experimental investigation of the disturbances caused by the instruments, and analysis of sediment-laden flow. U. S. Soil Conserv. Serv., SCS-TP-33, 34 pp., illus., July 1940.

Describes and presents results of experiments to determine the designs of the most efficient apparatus for the sampling of suspended load of streams based upon an analysis of the disturbances caused by the samplers and an analysis of sediment-laden flow.

2. The use of hydraulic models in the design of suspended-load samplers. *Amer. Geophys. Union, Trans.*, vol. 21, pt. 1, pp. 78-84, illus., July 1940. Describes hydraulic model studies to test the efficiency and reliability of suspended-load samplers and analyzes the physical aspects of the problem. The criterion for comparing samplers is considered and hydraulic test-methods are described. Results of experiments with the Eakin-Cutter-type and the horizontal-tube samplers are given and discussed. The mechanical designs of a multiple-unit and of single-unit line-suspended samplers are described.
- ORTENBLAD, ALBERTO.
1. Mathematical theory of the process of consolidation of mud deposits. *Jour. Math. and Physics*, (M. I. T.), vol. 9, no. 2, pp. 73-149, Apr. 1930. A mathematical treatment which considers the determination of the rate of sedimentation, specific weight, coefficient of permeability, etc. of mud deposits and with these data the state of stress, settlement, and water-content can be predicted at any time. Treats two cases, a sediment of homogeneous material and a sediment in which there exists a thin layer of less permeable material. Deals with consolidation due to weight of material, consolidation due to weight of top fill of very permeable material or evaporation, and consolidation by drainage. The theory which is developed holds for clays and fine grained deposits as well as muds.
- ORTH, F.
1. Die Verlandung von Staubecken (The silting of reservoirs). *Bautechnik*, vol. 12, no. 26, pp. 345-358, 1934. In German. Translation on file at the U. S. Soil Conservation Service, Washington, D. C., and the University of California, Berkeley, Calif. Discusses the merits of known experiments on alluvial sedimentation with the purpose of considering the alluvial deposit in a practical way in design and construction of dams. Comments on such items as loss of storage-space capacity, silting processes, protective measures, bed load, suspended load, life of reservoir, and flushing of reservoirs. Notes how properties and operation of the reservoir influence the deposits. Various formulas are given.
 2. Die Verlandung von Staubecken (The silting of reservoirs). *Deut. Wasserwirtschaft*, vol. 3, pp. 59-60, 1938. In German. Translation on file at the U. S. Soil Conservation Service, Washington, D. C. [Abstract], *Annali dei Lavori Pubblici*, vol. 76, no. 6, pp. 538-540, 1938. In Italian. Translation on file at the U. S. Soil Conservation Service, Washington, D. C. A brief discussion of general problems of reservoir silting. Expresses doubt as to the effectiveness of various methods of preventing the silting of reservoirs. Contains a table showing silting data for various reservoirs in the United States and comments on American investigations of reservoir sedimentation. The Italian abstract contains a table giving annual amount of sedimentation for various reservoirs in Italy.
- OSBURN, RAYMOND C.
1. The Bryozoa of the Woods Hole Region. *U. S. Bur. Fisheries Bul.*, vol. 30, pp. 205-266, illus., 1910. Presents results of survey, 1903-09, by the U. S. Bureau of Fisheries on the species of Bryozoa in the Woods Hole Region. Notes that Buzzards Bay is unfavorable to the growth of encrusting on sessile animals since its bottom is covered with silt deposited by streams which empty into the bay.
- O'SHEA, D. See Borer, O., 1.
- OTTO, GEORGE H.
1. Device for sampling heavy minerals [abstract]. *Geol. Soc. Amer. Bul.*, vol. 44, p. 159, 1933. Describes the use of a miniature sampler modelled after the Jones ore sampler for obtaining a representative heavy mineral sample for a microscope slide.
 2. Comparative tests of several methods of sampling heavy mineral concentrates. *Jour. Sedimentary Petrology*, vol. 3, no. 1, pp. 30-39, illus., Apr. 1933. Describes the causes of errors which are likely to arise in the selection of a sample of grains from heavy mineral concentrates and presents results of several mechanical methods of sampling in heavy mineral studies.
3. The use of statistical methods in effecting improvements on a Jones sample splitter. *Jour. Sedimentary Petrology*, vol. 7, no. 3, pp. 110-132, illus., Dec. 1937. Describes the technique of operation and methods used to measure the performance of the improved sample splitter.
 4. The sedimentation unit and its use in field sampling. *Jour. Geol.*, vol. 46, no. 4, pp. 569-582, May/June 1938. Considers the essential features for the systematic sampling of sedimentary deposits classified according to purpose—engineering, descriptive, environmental, and correlation sampling. Describes in detail the use of the sedimentation unit and outlines logical steps for the field determinations of sedimentation units. Gives field technique.
 5. (and Rouse, Hunter). Wind tunnel classifier for sand silt. *Civ. Engin.*, vol. 9, no. 7, pp. 414-417, illus., July 1939. Describes a wind-tunnel classifier for sorting granular material according to particle size. Utilizes the fact that sand and silt particles dropped in a horizontal stream of air are distributed in accordance with their "hydraulic size." The great advantage in this form of classifier is in the economy of construction and operation; the unit in use cost \$50 and was operated by one laborer.
 6. A modified logarithmic probability graph for the interpretation of mechanical analyses of sediment. *Jour. Sedimentary Petrology*, vol. 9, no. 2, pp. 62-76, illus., Aug. 1939. Presents a modified logarithmic probability graph for the interpretation of mechanical analyses of sediments. Various mathematical properties of mechanical analyses are mentioned. Describes the phi-probability graph, the extension of use of phi-probability graph to other types of mechanical analyses, the method of plotting the analysis, the graphical methods for determining parameters, and the graphical construction of theoretical analysis. Outlines a procedure for the systematic interpretation of analyses and discusses its advantages.
- OVERHOLT, VIRGIL. See Saveson, I. L., 1.
- OWENS, JOHN S. See also Griffith, W. M., 1.
1. Coast erosion. *Engineer [London]*, vol. 105, pp. 511-512, May 15, 1908. Discusses laws of transportation by shore waves along coast lines and contains general information on the laws of silt transportation by rivers.
 2. Experiments on the settlement of solids in water. *Geog. Jour.*, vol. 37, pp. 59-79, illus., Jan. 1911. Describes experiments on the settlement of solids on water, with a discussion of results. Lists and describes seven groups of experiments dealing with the fall of various-sized particles in water; density effects resulting from suspended matter; rate of fall of "surface of separation" in muddy water; size, quantity, and shape of suspended particles, and temperature of water as factors influencing rate of settlement of solids. The results are tabulated. N. F. MacKenzie comments on finding that smaller velocities are required to pick up solids than to keep them in suspension. Remarks are also made on the comparative rates of settlement of sand in clear and muddy water, the effect of experimental tube diameters on rate of falling of pebbles, and the importance of specific gravity of sand particles as a factor in their rate of settlement.
 3. Experiments on the settlement of sand in running water. *Geog. Jour.*, vol. 39, pp. 247-265, illus., Mar. 1912. Discusses experiments on the settlement of sand in running water and describes conditions under which they were performed in a small river and a laboratory. Treats equipment and specifications of sand grains used, and the method of arriving at conclusions and tabulating results. Effects of current velocities and turbulence, shape, size, and specific gravity of sand

grains, temperature of water, and other factors which influence the rate of settlement are given. Determinations are weighed and compared. Practical value of findings is noted.

4. The settlement and transport of sand in water. *Engineering*, vol. 94, pp. 862-864, illus., Dec. 20, 1912; [abstract], *Brit. Assoc. Adv. Sci.*, Rpt. 82, pp. 472-473, 1912.

Describes experiments dealing with the transportation and deposition of sand, the effect of temperature of water upon rate of settlement of sand, with the rate of sand transportation as bed load and its relation to velocity of current, and with the current velocity required to hold sand in suspension.

5. The transport and settlement of sand in water, and a method of exploring sand bars. *Engineer* [London], vol. 116, p. 343, illus., Sept. 26, 1913.

Describes some of the phenomena associated with sediment transportation and deposition. Several peculiarities of sand movement are considered and illustrated experimentally, the movement of sand ripples, the formation of quicksands, the erosion due to obstructions in a current, the influence of suspended matter on the specific gravity of a liquid, and the manner of settling of bodies in water. Describes an instrument for exploring sandbanks and river beds.

PACIFIC COAST ELECTRICAL ASSOCIATION. SUBCOMMITTEE OF HYDRAULIC POWER COMMITTEE.

1. Prevention of silt deposits in conduits. *Pacific Coast Electrical Assoc.*, 12th Annual Convention, June 12-15, 1928, pp. 160-171, illus.

Deals with the various factors to be considered in the design of sand traps and settling basins for the economical exclusion of silt, sand, and debris from power conduits. Includes discussion on bed- and suspended-load transportation, rates of settling of particles in water, the theoretical design of settlers, and types of settlers in use. Describes Kern No. 3 intake of the Southern California Edison Co., the Bear River Canal and the Spring Gap settlers of the Pacific Gas and Electric Co., and the settlers of the Powerdale Plant of the Pacific Power and Light Co. Gives description and results of tests on Kern No. 3 settling basin to obtain data which may be of value in the design of other settling basins relative to the path of silt through the basin, distance travelled, rate of deposition, and proportion of silt removed.

PACK, FREDERICK J.

1. Torrential potential of desert waters. *Pan-Amer. Geol.*, vol. 40, no. 5, pp. 349-356, illus., Dec. 1923.

Presents a detailed description of the flood of Aug. 13, 1923 in northern Utah, including local conditions within canyons that resulted in the extreme intensity of the flood. Conditions of stream erosion and debris transportation and deposition are also described.

PAFFORD, R. J., JR. See Benedict, P. C., 3.

PAGE, JOHN C. See Grover, N. C., 12.

PAINTER, WINSALL. See Smith, G., 1.

PAL, BHOLANATH.

1. On the motion of an ellipsoid of revolution in a viscous fluid in the light of Prof. Oseens objection to Stokes' treatment of the case of the sphere. *Calcutta Math. Soc., Bul.*, vol. 10, no. 2, pp. 81-94, 1919.

Considers the solution of the problem of the motion of the translation of an ellipsoid of the revolution of small ellipticity in a viscous fluid, the results being free from objections as pointed out by Prof. Oseens in Stokes' treatment of the case of the sphere.

PALMER, CHASE.

1. The geochemical interpretation of water analyses. *U. S. Geol. Survey, Bul.* 479, 31 pp., 1911.

Deals with the chemical character of natural waters with reference to the mineral structure of rocks of the region from which they are derived, to the solvent action of the waters on minerals which they contact, to sedimentary deposits they may form, and to their chemical action in general. Concludes that natural waters

may be definitely characterized, if dissolved salts are recognized, as a system of balanced values rather than as a load. Data on the character of waters of various streams in the United States are given, and the geochemical interpretation of results of analyses are discussed.

PALMER, FREDERICK. See Griffith, W. M., 1.

PALMER, HAROLD K. See Grover, N. C., 12; Wilm, H. G., 1.

PALMER, LEROY A.

1. A novel debris-dam. *West. Engin.*, vol. 6, pp. 59-62, illus., Aug. 1915.

Describes engineering details and effectiveness of a "basket" type debris dam constructed to impound the tailings of the Omega hydraulic mine, Nevada County, Calif. Estimates of the amount of sediment and gravel transported and deposited in the Sacramento and Yuba basins to 1880 are briefly noted.

PALMER, L. J. See Watts, L. F., 1.

PALMER, V. J. See Ree, W. O., 1.

PANDITTESEKERE, D. G. See Joachim, A. W. R., 1.

PARENT, R. C.

1. Silt load of the Saint John River and its tributaries; a preliminary report. *C. S. T. A. Rev. [Canada]*, no. 32, pp. 19-22, 27, Mar. 1942.

Discusses the sediment load of the St. John River, New Brunswick. Gives some idea of the annual loss of productive upland soil and how to prevent this loss. Describes a sampler which was constructed and used for sediment sampling. Includes a table which lists silt-load data from observations on the St. John River and its tributaries, Apr. 19-May 14, 1941. Advises letting the steepest hills grow up in trees, that medium slopes should be in pasture or rotations with clover and grass predominating, the use of manure to add humus to soil and aid its water holding capacity, and the use of ground limestone which increases the size of soil particles and infiltration rates.

PARKER, FREDERICK Y.

1. Repairing a break in a mattress bank protection [letter to editor]. *Engin. News*, vol. 61, no. 13, pp. 358-359, illus., Apr. 1, 1909.

Describes the repair of mattress bank protection of the Mississippi River at Cairo, Ill.

2. A dry-land mattress on the Mississippi. *Engin. News*, vol. 71, no. 23, p. 1243, illus., June 4, 1914.

Describes the use of a dry-land mattress on the Mississippi below Chester, Ill. The wreck of the Belle of Memphis in mid-stream, 1899, resulted in formation of a bar 1 1/2 miles long causing erosion of the Missouri shore. A secondary channel was formed and the old channel closed by a permeable pile dike. A woven brush mattress was sunk over the hurdle site.

3. Advantages shown for wire-willow mattress over basket-weave type. *Engin. News-Rec.*, vol. 96, no. 25, p. 1033, illus., June 24, 1926.

Describes the use of wire-bound willow mattresses instead of the basket woven willow type, saving 1/3 on the requirements for willow. Two examples are cited, a foot mattress to a revetment and a foundation mattress to a dike.

4. Basket-weave mattress revetment on the Missouri River. *Engin. News-Rec.*, vol. 106, no. 10, pp. 395-397, illus., Mar. 5, 1931.

Describes original revetment and revetment repair operations on the Missouri River utilizing the basket-weave mattress. Illustrations of actual operations explain this method of using bank and bar willows for revetment.

5. Missouri River abatis. *Mil. Engin.*, vol. 23, no. 132, pp. 535-536, illus., Nov./Dec. 1931.

Describes the development and use of a device, the abatis, for catching silt on the banks of a river, particularly the Missouri River. It was developed from the Brownlow Weed used in India which was floating brush anchored to the stream bed. From this evolved curtains, gratings, and wire netting buoyed, anchored, or secured to piles. Following this, devices based on weighted tripods, and cluster and single piles, were developed. The abatis was developed in 1897 for closing chutes but later was used to develop shore lines by causing silt de-

position. Describes use of the abatis at Baker's Bend, Mile 294, Missouri River. The abatis should not be used where there is scour or high current but only where there is an overflow at high water and fill is desired. The abatis is not a protective device, merely a silt catching means.

PARKER, HORATIO NEWTON. See also Stabler, H., 2.
1. Quality of the water supplies of Kansas. U. S. Geol. Survey, Water-Supply Paper 273, 361 pp., illus., 1911.

A paper on the quality of the water supplies of Kansas including 156 pages on the quality of surface waters. Discusses general drainage features of Kansas. Describes basins and quality of various stream waters in the lower Missouri, Kansas, Osage, Neosho-Verdigris, upper and central Arkansas, and Cimarron River basins, giving data on stream discharge, turbidity, dissolved- and suspended-load determinations, chemical analysis of dissolved solids, and other physical properties of water.

PARKER, JOHN D.

1. Cloud-burst in Arizona [letter to editor]. *Kans. City Scientist*, vol. 5, no. 5, pp. 74-75, May 1897. Describes the devastating effects of a cloud-burst that occurred in July 1890 seven miles west of Fort Bowie, Ariz. Notes conditions of erosion and deposition in the area affected.

PARKER, PHILIP A MORLEY.

1. The control of water as applied to irrigation, power and town water supply purposes. Ed. 2, 1055 pp., illus. London, G. Rutledge and Sons, Ltd., 1925. A book on hydraulics and the control of water for irrigation, power, and water supply purposes. Includes discussions on the silting up of reservoirs, removal of silt from reservoirs, causes of reservoir silting, and methods of prevention of reservoir silting; effect of silting upon the permeability of earthen dams, stream erosion, transportation and deposition; regime channels; sedimentation in irrigation canals; silt exclusion from canals; factors affecting the sediment load of streams; and the fertilizing and other properties of silt.

PARKER, THOMAS C.

1. (and Kittredge, Frank A.). Wire-bound rock training walls solve Zion Park flood problem. *Engin. News-Rec.*, vol. 115, no. 20, pp. 684-686, illus., Nov. 14, 1935.

Describes the construction and use of rock-filled wire basket dikes along the Virgin River in Zion National Park, Utah, each year since 1928. Prior to the dikes, canyon erosion was serious, and floods, due to overgrazing on the watershed, were bad, carrying silt down a 20-mile gorge. The formation of sand bars against boulders caused many changes of stream course. Earlier boulder-filled log crib wing dams did not withstand the floods. There was no material available at the site for rigid revetments; therefore, basket dikes, footed by toe revetment sections each 10-20 ft. long by 3-4 ft. in diameter, which rolled into place after under-cutting took place, were installed. The 4-ft. diameter toe revetments prevent undermining of the larger baskets. Wing dams of the same construction are used in addition to parallel bank protection. Cross-stream dams are being considered but have not yet been tried. Height may be added to dikes by adding rock. The area behind dikes silts up slowly and at the same time current is maintained in the desired stream channel between dikes. Baskets are made of heavy wire mesh.

PARKHURST, V. R.

1. Floods on the Kaw River. *Kans. Engin. Soc., Trans.*, vol. 8, pp. 18-20, 1919. Proposes means for the systematic lessening of flood damages of the Kaw River by eliminating the various conditions of erosion which tend to build up the river bed.

PARKINS, A. E.

1. A waste filled valley [abstract]. *Mich. Acad. Sci., Art, Letters, Ann. Rpt.*, 12, p. 53, illus., 1910. Briefly outlines the characteristics of the valleys of intermittent streams along the Huron River between Ypsilanti and Dexter, Mich., which evidence that filling has taken place and

was probably produced by an increase in supply of waste material from the headwaters because of the cutting away of forests.

2. Valley filling by intermittent streams. *Jour. Geol.*, vol. 19, no. 3, pp. 217-222, illus., Apr./May-1911.

An article relative to valley filling by intermittent streams. Notes that many intermittent streams are actively aggrading part or all of their valley, contrary to the thought that streams having steep grades are in active vertical erosion. Cites Jewell's Creek near Ypsilanti, Mich., as an example of valley filling. In all such valleys there is an interruption in the normal cycle of erosion caused by an increase in the supply of waste brought to the headwaters. When the supply is decreased, the stream will clear away the waste and normal erosion will occur.

PARKINSON, DANA.

1. Range lands and the Boulder Dam. *Amer. Forests and Forest Life*, vol. 35, no. 10, p. 618, Oct. 1929. Discusses the relationship between range lands in the Colorado basin and the storage capacity of Boulder Dam. Using a basis of 33 lbs. to a cu. ft., it is estimated that suspended matter carried past Grand Canyon in 1925-26 would occupy 313,000 acre-feet if deposited in a reservoir; in 1927-28, 617,000 acre-feet. Neither sluicing nor dredging will solve the problem practically; the solution is to keep the soil in its original place by practical range management.

PARMELEE, CHARLES L.

1. (and Ellms, Joseph W.). On rapid methods for the estimation of the weight of suspended matters in turbid waters. *Technol. Quart.*, vol. 12, no. 2, pp. 145-164, June 1899; [abstract], *Engin. Rec.*, vol. 40, no. 10, pp. 229-230, Aug. 5, 1899.

Presents results of a study to determine the applicability of turbidity determinations, by comparison with standard, photo-comparator, wire, and diaphanometer methods, to Ohio River water at Cincinnati. Estimations of weight of suspended matter are based upon the relation which turbidity of waters bears to weight of suspended matter present.

PARMELEE, L. R.

1. The high water fight at Old Town, Arkansas in 1922. *Amer. Soc. Civ. Engin., Trans.*, vol. 87, pp. 993-994, illus., 1924.

Describes conditions of bank erosion and methods of stream-bank protection on the Mississippi River during the high-water fight at Old Town, Ark.

PARSHALL, R. L. See also Griffith, W. M., 1; Wilm, H. G., 1.

1. Sand trap for canals works on vortex principle. *Civ. Engin.*, vol. 1, no. 5, p. 418, illus., Feb. 1931.

Describes a vortex sand trap to dispose of silt, sand, and gravel that enter headgates of irrigation canals. Notes methods of using riffles or cleats on the bed of the channel to set up cross currents in order to divert the bed load.

2. The removal of bed load from artificial channels.

Amer. Geophys. Union, Trans., vol. 15, pt. 2, pp. 603-606, June 1934; [abstract], *Amer. City*, vol. 49, p. 7, Nov. 1934.

Deals with studies concerning method for removal of bed load from artificial channels using various sand-trap devices in which the effect of cavitation in flowing water is the basic principal. Studies were conducted by Division of Irrigation in cooperation with the Colorado Agricultural Experiment Station at the Bellvue Hydraulic Laboratory near Fort Collins, Colo. Three types of traps have been tested, namely the vortex-tube, the riffle deflector and the grating type. Laboratory-settlings of these devices indicate their effectiveness in capturing bed-load which moves downstream along bottom of channel. Describes construction of sand-traps, mode of operation, laboratory observations, field installations and relative effectiveness. Portrays laboratory in operation on Alamo River in the Imperial Valley near El Centro, Calif., constructed for the purpose of studying methods of removing fine sand and silt carried in that stream under conditions essentially the same as those in the Colorado River.

Discussion: F. W. KERNS, and N. EGBERT, pp. 606-611, comment on the effectiveness of riffle-deflector trap, grating type of trap, and horizontal vortex-tube in the removal of bed-load, and on the removal of suspended load, silt, and fine sand by spiral flow. Model studies prove that spiral-flow action offered a solution for the removal of fine sand and silt from a stream of water by the introduction of a curved channel into the stream. Describes model studies of D. A. Yarnell on spiral flow at the University of Iowa noting that a five-foot outside diameter model removed 90 percent of Sacramento River sand and silt. Portrays experimental tangential channel and combination tangential and multichannel apparatus as forms of preliminary sedimentation channels, and outlines their effectiveness. In conclusion, states that all methods for removal of solids from liquids are based on sedimentation, and the time necessary for sedimentation is directly proportional to depth of settlement, so that if depth can be greatly reduced by multiple channels, and solids automatically removed in high state of concentration, the efficiency of the process is improved.

3. Sand trap for self-cleaning of canals and streams [abstract]. Public Works, vol. 65, no. 11, p. 16, Nov. 1934.

A paper presented at the joint meeting of the American Society of Agricultural Engineers and Hydrology Section of the American Geophysical Union, June 21, 1934, describing in detail the installation and operation of several types of sand traps developed by the author by which a small part of stream can be diverted through them to carry out of main stream a concentrated load of sand, silt, and debris.

4. Riffle deflectors and vortex tubes remove suspended silt and sand. Civ. Engin., vol. 17, no. 12, pp. 34-35, Dec. 1947.

Describes sand trap designed to remove bed load and gravel from water directed from the Arkansas River at heading of the Mineguate Union Canal near Pueblo, Colo. A riffle-deflector and vortex-tube type of sand trap was chosen as best suited. Design details are given.

PARSON, A. L. See Walker, T. D., 1.

PARSONS, H. F.

1. Proper control of Mississippi River will provide navigable waterway for Central States. Hydraulic Engin., vol. 4, no. 2, pp. 77, 115-117, Feb. 1928. Describes conditions necessitating proper control of the Mississippi River to provide a navigable waterway for the Central States. Includes two paragraphs noting that the Mississippi River carries annually to the Gulf 400,000,000 tons of sediment (the same amount it receives from the Missouri River), and that the use of by-passes, spillways, and safety outlets would be ineffective since the river has a tendency to silt up below openings because of the reduction in velocity at these points.

PARSONS, W. J., JR. See Dodge, B. H., 1.

PARTIOT, HENRI LEON.

1. Estuaries. Inst. Civ. Engin., Minutes of Proc., vol. 118, pp. 47-77, 1894. Divides estuaries or inlets on or near the sea coast into two classes: (1) estuaries without rivers; (2) estuaries into which rivers flow. Discusses the various types of estuaries. Deals with the estuary of the Seine, the Tyne, the Liffey, the Slaney, the Tees, the Foyle, the Tagus, the Gironde, the Tay, and the Maas.

PARTIOT, M. LEAN. See Hooker, E. H., 1.

PASADENA, CALIF. WATER DEPT.

1. Twenty-fifth annual report, 1937-1938. 69 pp., illus., 1938. Notes damage incurred from sand and debris deposits in the water-collecting system and supply mains in the Arroyo Seco and Eaton Canyons during the flood of Mar. 2, 1938. Over 1,500,000 cu. yd. of material was deposited in Devils Gate Reservoir; at upper Eaton Diversion, rock and sand filled the bottom of the canyon, covering the submerged dam and intake works with a layer 5-8 ft. thick; material

brought into the Morris Reservoir amounted to 1400 acre-feet, reducing its capacity 3.57 percent; San Gabriel Dam No. 1 held back 5,200 acre-feet of silt and debris which otherwise would have been deposited in the Morris Reservoir. At this time (1938), 1/3 of the capacity of Devils Gate Reservoir has been lost by silt deposits and the total capacity of Morris Reservoir is now 37,174 acre-feet.

PASCHKE, THEODORE. See Sorzano, J. F., 1.

PASCALON, P. See Armand, L., 1.

PATRASHEV, A. N.

1. Pressure flow of ground water carrying fine sandy and clayey particles [abstract]. Sci. Res. Inst. Hydrotechnics, Trans., vol. 15, pp. 95-98, illus., 1935.

Deals with a model study on the pressure flow of ground water carrying fine sandy and clayey particles. Discusses the model devised by Prof. H. N. Parlovsky in which flow is represented by a system of curvilinear percolation tubes; gives equations. Notes that all hydrodynamical elements of flow can be expressed by means of finite functions and concludes that solutions obtained may be applied to a series of engineering problems including reservoir silting.

2. Pressure flow of ground water carrying fine sandy and clayey particles [abstract]. Sci. Res. Inst. Hydrotechnics, Trans., vol. 16, pp. 102-103, 1935.

Deals with a study of the hydrodynamic elements of stream flow and the dynamics of the motion of solids coincident with the process of silting. Compares the theoretical solution with experimental results.

PATRICK, J. G.

1. A study of total solids, manganese and acidity and their courses downstream of north branch on north branch of the Potomac River. W. Va. Engin. Expt. Sta., Tech. Bul. no. 6, pp. 52-65, illus., Nov. 1933.

Presents results of a study to determine the quantity of dissolved and suspended material carried by the Potomac River from above the entrance to Piney Swamp Run to the mill intake at the Mill Dam, Luke, Md., and to determine the contributions of material by Piney Swamp Run and Savage River. Samples were collected semi-weekly Mar. 27-Sept. 25, 1931.

PATTERSON, C. B. See Simmons, H. B., 1.

PATTISON, W. F. See Borer, O., 1.

PATTY, I. H. See Vogel, H. D., 8.

PAUL, C. H. See Marx, C. D., 1.

PAUL, GEORGE F.

1. Keeping a river in place with a board mattress. Sci. Amer., vol. 121, no. 25, p. 609, illus., Dec. 20, 1919.

Briefly describes the construction and use of a strong board mattress, weighted with riprap, to prevent damage to the bed of a river in the Little River drainage district, Mo.

2. Anchored mats of trees curb erosion. Prof. Engin., vol. 14, no. 10, pp. 21-22, illus., Oct. 1929. Describes a method of bank protection by the use of current retards.

PAULSEN, M.

1. River protective work. New Zeal. Jour. Agr., vol. 19, no. 5, pp. 271-276, illus., Nov. 20, 1919.

Describes the river protection work on the Makarutu River, at Takapau, Hawke's Bay, New Zealand. Discusses the construction and placing of groynes, and fencing and planting on the river bed. Offers data on the results achieved.

PEARCE, J. R. See Briggs, L. J., 1.

PEARSON, A. N.

1. Analyses of river water [abstract]. Engin. News, vol. 27, no. 16, p. 367, Apr. 16, 1892.

A report dealing with analyses of the river waters of Australia to determine their value for fertilizing and irrigation purposes. Notes that samples taken from the Murray, Goulbourn, Werribu, and Lerderburg Rivers show the principle fertilizing value to be the matter in solution rather than in the sediment.

PEARSON, J. C.

1. (and Sligh, W. H.). An air analyzer for determining the fineness of cement. U. S. Bur. Standards, Tech. Paper, 48, 74 pp., illus., 1915.

Describes and gives method of operation for an elutriation method of mechanical analysis which

employs the use of air. This analyzer can be adapted to the separation of other materials than cement; notes that excellent separations have been made of ground quartz, emery, and other hard-grained materials.

PEARSON, R. W. See Troug, E., 1.

PEARSONS, GALEN W. See Hazen, A., 2.

PEATTIE, RODERICK. See Atwood, W. W., 1.

PECK, ALLEN S.

1. Dirt engineers. Colo. Soc. Engin., Denver, Engin. Bul., vol. 18, no. 8, pp. 3, 9-11, Aug. 1934.

Deals with conditions of accelerated erosion in the United States, its causes and effects. The effect of depletion of plant cover upon water supplies is briefly considered. Brief data on rates of silting in Elephant Butte, Roosevelt, and Boulder Reservoirs are given. Notes that the Farmer's Union Reservoir, in a well forested and managed watershed, when drained after 25 yr. of operation showed wagon tracks on the bottom which had been made prior to the building of the dam. Silt damages due to the flood of Dec. 30, 1933 in Pickens and San Damis Canyons, Calif., are briefly noted.

PECKOVER, F. LIONEL. See Lane, E. W., 21.

PECKWORTH, HOWARD F. See Campbell, F. B., 1.

PEDERSEN, KAI O. See Svedberg, T., 3.

PEDERSON, CLARENCE. See Coldwell, A. E., 2.

PELLET, H.

1. (and Roche, R.). Composition of Egyptian soils and Nile-ooze. Internatl. Sugar Jour., vol. 9, no. 105, pp. 442-449, Sept. 1907.

Presents results of analyses on the chemical composition of soils and Nile-ooze, Nag-Hamadi region, Egypt. Notes fertilizing value of Nile-ooze.

PENCK.

1. The River Etsch. Deut. u. Oesterr. Alpenverein, Ztschr., vol. 26, pp. 1-15, 1895; [abstract], Science, vol. 4, no. 101, p. 829, Dec. 4, 1896. Abstract of a technical article describing the River Etsch (or Adige, Italy). Notes conditions of degrading and aggrading of stream, also the deposition of detritus brought in by lateral streams forming fans at their mouths.

PENNINGTON, R. P. See Jackson, M. L., 1.

PENNSYLVANIA STATE PLANNING BOARD.

1. Conclusions and project list for Delaware River basin in Pennsylvania. Pa. State Planning Bd., Pub. 10, pt. 1, pp. 113-141, illus., 1937. Deals with flood control recommendations for the Delaware, Lehigh, and Schuylkill Rivers, and lists projects proposed for the comprehensive development of the Delaware River basin in Pennsylvania. Notes briefly conditions of silting in the lower Schuylkill River which are menacing existing improvements.
2. Delaware River sub-basin. Pa. State Planning Bd., Pub. 10, pt. 1, pp. 1-45, illus., 1937. Deals with the hydrology of the Delaware River basin. Includes a brief discussion on conditions of erosion and silting in the basin. Notes that accumulations of sediment, in the form of culm mixed with silt, exist along the lower course of the Delaware, having been brought down from anthracite regions on the Lehigh and Schuylkill Rivers.
3. Lehigh River sub-basin. Pa. State Planning Bd., Pub. 10, pt. 1, pp. 45-79, 1937. Deals with the hydrology of the Lehigh River basin, Pa. Notes the effect of influx of mine drainage from anthracite regions on the quality of Lehigh River water; culm and silt are carried by the stream into the Delaware River. States that erosion estimates indicate that silting in proposed reservoirs in the basin would amount to not more than 2 percent of the reservoir capacities in a decade.
4. Pollution of streams and underground waters. Pa. State Planning Bd., Pub. 10, pt. 1, pp. 29-34, 1937. Deals with the sources of stream pollution in the Delaware River basin in Pennsylvania. Notes briefly conditions of erosion in the basin, and existence of sediment accumulations along the lower course of the Delaware.
5. Schuylkill River sub-basin. Pa. State Planning Bd., Pub. 10, pt. 1, pp. 79-111, 1937. Deals with the hydrology of the Schuylkill Basin, Pa. Notes briefly conditions and effects of culm and mud deposits in the stream.

PENNSYLVANIA WATER SUPPLY COMMISSION.

1. Water resources inventory report II. Turtle Creek investigation for the improvement of flood conditions. 52 pp., illus. Harrisburg, Pa., 1916.

Presents results of study and investigation of existing conditions and proposed improvements in and along the lower reaches of Turtle Creek, Allegheny County, Pa., with a view towards minimizing flood damages. Gives geology, topography, and hydrology of the drainage basin, and scattered data on deposition in and raising of the channel. Describes channel slopes and alignment, bank erosion, runoff, and obstructions on the stream. Sediment was 3-5 ft. deep in the channel below tributaries and silt to a depth of 6-8 ft. occurred in the backwater of the dam on the Monongahela River. Describes economic developments in Turtle Creek Borough; quality of Turtle Creek waters; floods in Turtle Creek, backwater floods, floods of local origin, and flood damages; and methods of amelioration of flood conditions.

2. Water resources inventory report X. Culm in the streams of the anthracite region. 157 pp., illus. Harrisburg, Pa., 1916.

Describes conditions of culm and silt transportation and deposition in streams of the anthracite region of Pennsylvania, damage to streams and to alluvial flats within flood zones, and river coal recovery operations.

PERKINS, FRANK C.

1. Aids to navigation on the Missouri River. Sci. Amer. Sup., vol. 75, no. 1937, pp. 100-101, illus., Feb. 15, 1913.

Describes the details of construction of concrete dikes for the improvement of the Missouri River at Elwood Ben, Mo., and Fort Reilly, Kans.

PERROTT, G. ST. J.

1. (and Kinney, S. P.). The meaning and microscopic measurement of average particle size. Amer. Ceramic Soc. Jour., vol. 6, no. 2, pp. 417-439, Feb. 1923.

A report which presents an analysis of the term "particle size" or "average particle size." Sets forth a method of calculating the average particle size which gives a value capable of physical interpretation. Gives the results of measurements of pulverized coal and calculations of average particle size. The work was done in connection with the Trent Process for cleaning finely ground coal.

PERRY, LYN. See Camp, T. R., 2.

PETERSON, H. V. See also Brown, C. B., 32; Stevens, J. C., 6.

1. The gully problem. Reclam. Era, vol. 34, no. 1, pp. 2-4, illus., Jan. 1928.

Considers the general aspects of the gully problem. Notes the cutting of various gullies in the Southwest for which the beginning date is known. Treats various causes of gullies and the efforts by those interested in conservation, in controlling erosion, and gully cutting.

PETERSON, JOHN Q. See Troxell, H. C., 1.

PETERSON, WILLIAM. See Saville, T., 5.

PETTIJOHN, F. J. See also Krumbein, W. C., 14; Rogers, J., 1; Tyler, S. A., 1.

1. Determination and calculation of sphericity values of pebbles. Jour. Sedimentary Petrology, vol. 6, no. 2, pp. 154-157, illus., 1936.

Presents and explains the use of an alignment chart for computing sphericity of pebbles and small cobbles.

2. Mineral analysis of sediments. In Trask, P. D., ed. Recent marine sediments; a symposium, pp. 592-615, illus. London, T. Murby and Co., 1939.

Outlines methods commonly used for the mineral analysis of sediments involving the disaggregation and clarification of grains such as mineral separation by use of heavy liquids, centrifuge, and other means, which result in the isolation of minor accessory minerals. Discussions are included on methods of splitting and mounting heavy residue for microscopic study, identification of minerals by optical means, and determination of mineral frequencies. Remarks relative to variations in the mineral composition of samples are given.

discussing the nature of and factors effecting these variations; also the correct interpretations of observed variations. References are included.

3. Mineralogy of sedimentary rocks, 1937-1939. Natl. Res. Council, Div. Geol. and Geog., Com. on Sedimentation Rpt. 1939-40, pp. 22-69, Dec. 1940.
A bibliography emphasizing the mineralogy of common sediments and reviewing techniques applicable to such materials. Consists of 160 articles pertaining to this field.
4. Quantitative and analytical sedimentation. Natl. Res. Council, Div. Geol. and Geog., Com. on Sedimentation Rpt. 1940-41, pp. 43-61, Mar. 1942.
Analyzes modern phases and significant trends in the past two decades in sedimentology. Discusses the quantification of data and analytical data. Gives a selected bibliography on quantitative and analytical sedimentation.
5. Sedimentary rocks. 526 pp., illus. New York, Harper and Bros., 1949.
Deals with the properties of sedimentary rocks, kinds of sedimentary rocks, and processes which form sedimentary rocks. Considers sorting, abrasion, deposition, lithification, etc.

PETTIS, C. R. See Lane, E. W., 4.

PÉWÉ, TROY L.

1. Deposition of sediment in Pool No. 15 at Rock Island, Illinois. Jour. Sedimentary Petrology, vol. 14, no. 3, illus., pp. 115-124, Dec. 1944.
Discusses deposition of sediment in the pool bottom upstream from Dam 15 at Rock Island, Ill. Comments on the upper Mississippi River 9-ft. channel navigation project. Various cross sections for the lower end of Pool No. 15 are given.
2. Deposition of sediment in the Iowa River at Iowa City, Iowa. Iowa Acad. Sci., Proc. (1945), vol. 45, pp. 212-218, illus., 1946.
Deals with the deposition of sediment in a pool (Iowa City pool) which was created by the construction of a dam across the Iowa River at Iowa City, Iowa. Includes data on the rate of silting in the pool. Gives various features concerned with soundings taken.
3. Suspended sediment program of the Rock Island Office, Corps of Engineers, U. S. Army. Jour. Sedimentary Petrology, vol. 16, no. 3, pp. 97-109, illus., Dec. 1946; [abstract], Chem. Abs., vol. 41, no. 4, p. 929, Feb. 20, 1947.
Discusses the sediment program which the Rock Island Office, Corps of Engineers, U. S. Army, has carried on since 1940. Describes the use of sampling equipment, particularly the Rock Island Simplified Time-Integrating Sampler developed in 1939. Samples are analyzed for total sediment content and some samples are analyzed for size-grade distribution by using the decantation method.

PFUND, A. H. See Stutz, G. F. A., 1.

PHARR, HARRY N. See Matthes, G. H., 6.

PHILLIPS, H.

1. (and Alvord, John W., and Billingsley, J. W.). A report to the Mayor and Board of Commissioners of Oklahoma City on an improved water supply for the city. 232 pp., illus. Feb. 15, 1913.
Presents results of investigations on the existing and proposed water supply for Oklahoma City, Okla. Includes discussion on probable silt deposits in storage reservoirs. Data are given on the silting up of the Austin Dam and Reservoir; the relation between percentage of sediment by volume compared to percentage by weight; and the reduction in volume of sediment. Presents results of an investigation of the amount of silt deposited in the sedimentation basins of the Oklahoma City filtration plant and the amount of sediment removed from the basins during 1912, together with flow of river and corresponding sediment carried. Results of silt determinations on the Mississippi, Brazos, Wichita, Colorado and Rio Grande Rivers are briefly summarized. Gives computed sediment in the North Canadian River at Oklahoma City, and probable silt deposits in the proposed Oklahoma City Reservoir.

PHILLIPS, P. See Hurst, H. E., 3.

PICKELS, GEORGE W. See also Leonard, F. B., 1.

1. Drainage and flood-control engineering. Ed. 2. 476 pp., illus. New York, McGraw-Hill Book Co., Inc., 1941.

Deals with the various engineering aspects of drainage and flood control in the United States. Includes discussions on the transporting power of flowing water, the stability of open channels, permissible canal velocities, and the effect of silting and scouring upon a channel; factors to be considered in the design of drainage ditches to prevent erosion and silting, use of sedimentation basins and check dams to reduce erosion and sedimentation, and maintenance of ditches; flood protection by channel improvement; bank protection by levees and by reservoirs. Flood control in Los Angeles County, Calif., is briefly considered; including tabular data on rates of silting of 16 flood-control dams built by the Los Angeles County District.

PICKETT, A. B.

1. Uncompacted mass asphalt paving for river banks and levees. Civ. Engin., vol. 16, no. 10, pp. 451-453, illus., Oct. 1946.

Describes the use of uncompacted mass asphalt paving on the Mississippi River in the New Orleans District. Gives the construction advantages, such as 95 percent of the material in the mixture is produced locally in the river; a small crew is needed with ordinary equipment; does not need forms, screeds, or expansion joints; work can be awarded by contract.

PIEN, CHUNG-LING. See also Kalinske, A. A., 10.

1. Investigations of turbulence and suspended material transportation in open channels. June 1941. Thesis (Ph. D.) - State University of Iowa; [abstract], Iowa Univ., Studies in Engin., Bul. 33, p. 57, 1949.
A study of turbulence characteristics of open channels that are important in suspended-load transportation, measurement of suspended material concentration, and relations between bed and suspended material. Makes qualitative determinations of the diffusive power of turbulence, bed behavior, and concentration of sediment near the bed.

PIERCE, RAYMOND C.

1. The measurement of silt-laden streams. U. S. Geol. Survey, Water-Supply Paper 400-C, pp. 39-51, illus., Nov. 4, 1916; [abstract], Wash. Acad. Sci. Jour., vol. 7, no. 4, p. 136, Feb. 1917.

Describes difficulties encountered and results obtained in measuring the flow of the heavily silt-laden San Juan River. Describes regimen of the river and site of the gaging station established by the U. S. Geological Survey 100 miles above the mouth of the river. Silt movement in the San Juan River is discussed in detail, noting the average content of silt to be 0.37 percent by weight for the period May 16-June 30, 1915 and 0.44 percent from Oct. 18, 1914 to Aug. 2, 1915. The effect of floods on the silt content of the river and the movement of the bed load of the river as "sand waves," are noted. Difficulties are encountered in making discharge measurements in a silt-laden river because of high velocities, large amounts of trash and drift carried in suspension, shifting channel, and rapid fluctuations in the river stage. Means employed to overcome difficulties are described. Gives result of discharge measurements made at the San Juan gaging station, together with a diagram showing rating curves, area curves, and velocity curves.

PIETERS, H. A. J.

1. (and Hovers, J.). Sedimentation analysis. Fuel in Sci. and Prac., vol. 25, no. 5, pp. 138-147, illus., Sept./Oct. 1946.

Discusses methods of sedimentation analysis. Treats of the "Pipette Method" and the "State-Mines Method." Describes an indirect method based on velocity of fall in a viscous medium; the size of the particle is expressed as the sedimentation-diameter.

PILLAI, K. PADMANBHA.

1. Remodelling channels and sluices in the Cauvery Delta Tour. Inst. Engin., Calcutta, Jour., vol. 17, pp. 69-105, illus., Aug. 1937; [abstract], Civ. Engin. and Pub. Works Rev., vol. 32, p. 21, Jan. 1937.

A paper on remodelling of channels and sluices in Cauvery Delta, India. Gives defects in the delta and suggested remedies. Discusses silting up of rivers (branches) in the delta because of great variations in widths of channels, also inefficiency of scouring sluices of weirs (anicut). Proposes a solution by establishing protective growth along the river margins and other training works to maintain uniform river width. Discusses a survey on critical river width, remodelling of sluices, principles adopted in remodelling, form and size of vents, and cost of remodelling.

PILLSBURY, GEORGE B.

1. Experiments on the Delaware River. *Military Engin.*, vol. 22, no. 121, pp. 22-24, illus., Jan./Feb. 1930.

Describes the maintenance of a channel in the Delaware River between Philadelphia and the sea, and model experiments undertaken to determine training works for the river at Deepwater Point Range near Pea Patch Island to eliminate the mud shoals which fill up the channel. Design and construction of the model are described. Experiments are outlined describing the various spur and longitudinal dikes tried in the model. The curved upstream dike was chosen as most useful. Sawdust was used to trace currents and shoaling in the model; powdered cake was unsatisfactory.

PINTARD, JOHN.

1. Description of the Mississippi River. *Farmers' Cabinet*, vol. 1, no. 43, p. 2, Sept. 1, 1803. Contains important historical data relative to the rate of growth of the Mississippi River Delta.

PIPER, ARTHUR M.

1. Investigation in process in hydrologic laboratories. *Amer. Geophys. Union, Trans.*, vol. 12, pp. 219-220, 1931.

Briefly summarizes investigations in progress in various hydrologic laboratories. Notes work of H. J. Fraser on studies of porosity and permeability in relation to processes of deposition and of cementation in sediments; studies by R. Eckis and P. B. K. Gross on the relation of several hydrologic properties of a material to its mechanical analysis; and studies by C. H. Lee on the relations of the hydrologic properties of materials to engineering problems.

2. Hydrologic and hydrographic investigations that bear on sedimentation, 1932-1933. *Natl. Res. Council Bul.* 98, pp. 172-194, July 1935.

Presents a comprehensive summary of pertinent data bearing on the principle and processes of sedimentation and on the character and extent of natural sediments as gathered by Federal, State and other governmental agencies in connection with various hydrologic and hydrographic investigations during 1932-33. Covers field investigations which bear on the source, transportation and deposition of sediment; laboratory investigations dealing with the dynamics of transportation and sedimentation; and studies relative to the character and extent of natural sediments and sedimentary rocks.

PITTSBURGH BOARD OF HEALTH.

1. Annual report, 1879. 100 pp., illus. Pittsburgh, Pa. (Pamphlet vol. 429).

Notes that the Allegheny River at Pittsburgh is a clear sparkling stream, while the Monongahela, which joins it to form the Ohio River, is never known to be perfectly clear or transparent. Indian names reflect these conditions.

PITTSBURGH DEPT. OF PUBLIC WORKS. BUREAU OF WATER. FILTRATION DIVISION.

1. Report. Pittsburgh Dept. Pub. Works, Bur. Water, Ann. Rpt., 1912, pp. 11-104, illus., 1913. Includes data on 2-hr. turbidity readings for Allegheny River water at Ross (February 1912-January 1913), on daily silica turbidities, suspended solids, and coefficient of fineness of suspended solids (February 1912-January 1913), and on mineral analyses of river water made from weekly composite samples (February-November 1912).
2. Report. Pittsburgh Dept. Pub. Works, Bur. Water, Ann. Rpt., 1913, pp. 9-92, 1914. Includes data on 2-hr. turbidity readings and on

daily silica turbidities, suspended solids, and coefficient of fineness of suspended solids of the Allegheny River water (February 1913-January 1914).

PLUMLEY, WILLIAM J.

1. Black Hills terrace gravels: a study in sediment transport. *Jour. of Geol.*, vol. 56, no. 6, pp. 526-577, illus., Nov. 1948.

Reports the mapping of terraces along three streams flowing eastward from the Black Hills of South Dakota; five erosional surfaces were found which represent major pauses in the downcutting activity of the regional drainage. Knickpoints in the present-day stream profiles indicate that the more recent terraces of this region are the result of factors controlling downcutting in the Missouri and Cheyenne Rivers. Mechanical analyses were made of sediment samples; the rate of rounding was found to be directly proportional not only to the difference between the roundness at some point and a limiting roundness but also to some power of transported distance. Attempts to express quantitatively the effects of stream transport on roundness and lithology in respect to "indices of maturity."

PODUFALY, E. T.

1. (and Noble, C. C.). Investigation of mixing criteria for density currents. 48 pp., illus., tables and graphs, May 20, 1948. Unpublished thesis (M. S.)—Massachusetts Institute of Technology.

An investigation of the mixing characteristics of density currents. Develops a laboratory technique for a series of experiments to obtain data to further the study of the mixing characteristics of density currents. Experiments consisted mainly of the use of a flume in which a dense fluid is passed under a lighter fluid. Gives a description of the equipment and procedure. States various conclusions reached as a result of the study.

POHL, CHARLES A. See Sonderegger, A. L., 1.

POLIAKOV, B. V.

1. New type of sampler for measurement of sandy bottom silt. *Sci. Res. Inst. Hydrotechnics, Trans.*, vol. 7, 1932. In Russian. Translation on file at the U. S. Soil Conservation Service, Washington, D. C. Describes a new type of sampler for determining the quantity of sand moving at the bottom of large and deep rivers. Gives the advantages and disadvantages of the apparatus which can measure the velocity of any silt or current as long as the river is deep. It was proposed to use this apparatus for hydraulic work on the Volga and Dnepr Rivers.

2. Influence of dam construction on the Volga River upon the regime of silt and crossings. *Sci. Res. Inst. Hydrotechnics, Trans.*, vol. 9, pp. 145-161, illus., 1933. In Russian with abstract in English. Translation on file at the U. S. Soil Conservation Service, Washington, D. C., and the University of Minnesota, Minneapolis, Minn.

Discusses the influence of dam construction upon the regime of crossings and silt deposition in the Volga River, U. S. S. R.

POLLITZER, S. J.

1. River erosion and their prevention. *Commonwealth Engin.*, vol. 5, no. 1, pp. 20-23, illus., Aug. 1, 1917.

Gives elementary information on improving Australian rivers to prevent bank erosion, with its consequent widening and silting up, and to provide rivers with permanent stable channels of sufficient depth to maintain navigation. Discusses erosion on convex sides of bends and methods of prevention by levees or spur dikes (groins), use of fascines for river improvement and of diversions to improve navigability of streams.

POOR, R. S.

1. [Review of] Silting of reservoirs, by H. M. Eakin. *Jour. Sedimentary Petrology*, vol. 7, no. 1, pp. 36-37, Apr. 1937.

Reviews a technical bulletin (Eakin, H. M., 9). Describes briefly the object of studies by the U. S. Soil Conservation Service on reservoir silting and value of results. Summarizes the bulletin with respect to data on conditions of

erosion and processes of reservoir silting. That delta deposits in a reservoir represent total sediment is erroneous since sediment is deposited throughout the length of the reservoir due to underflow and the deposition which occurs in deeper portions at selective rates from the beginning of storage. Briefly discusses conditions of underflow in reservoirs. Describes results of previous investigations on reservoir silting, noting that Roosevelt Reservoir accumulated 101,000 acre-feet of sediment in 14 yr.; reservoir surveys by the U. S. Soil Conservation Service in 1934-35, and results.

PORTER, BERNARD H.

1. Determination of particle size by electron diffraction. *Electronics*, vol. 9, no. 10, pp. 44, 46, Oct. 1936.

Describes the use of electron diffraction to determine particle size. A qualitative estimation of particle size can be made from recorded diffraction patterns by interpreting the pattern rings.

PORTLAND CEMENT ASSOCIATION. CHICAGO.

1. Concrete structures for flood control; soil and water conservation. 47 pp., illus. Chicago, 1937. Describes various stabilizing structures such as check and debris dams and gully-head plugs. Various types of water storage and diversion structures are described. Protective devices such as channel lining, revetments, flood walls, and contraction works are discussed.

POST, GEORGE M. See Robinson, H. F., 1.

POST, WILLIAM S.

1. Santa Ana investigation—Flood control and conservation. Calif. Dept. Pub. Works, Div. Engin. and Irrig., Bul. 19, 357 pp., illus., 1929. Presents results of a study and suggests solutions for flood control and conservation on the watershed of the Santa Ana River, within the counties of San Bernardino, Riverside, Orange, and Los Angeles. Includes brief discussions on conditions and quantity of debris transportation, scour and silt, and bank protection.

POSTEL, A. WILLIAMS.

1. The preparation of clay samples for elutriation by stream agitation. *Jour. Sedimentary Petrology*, vol. 3, no. 3, pp. 119-120, illus., Dec. 1933. Describes a method of preparing clay samples for elutriation, the samples being agitated by means of a jet of live steam under pressure.

POTTER, W. D.

1. (and Love, S. K.). Hydrologic studies at the West Tarkio Creek Demonstration Project, Shenandoah, Iowa. U. S. Soil Conserv. Serv., SCS-TP-42, 5 pp., illus., tables and graphs, June 1941. Includes hydrologic and land-use data collected at the West Tarkio and Tarkio River watersheds during 1934-40. Contains data on suspended-load measurements of silt in the Tarkio River and West Tarkio Creek.
2. (and Love, S. K.). Hydrologic studies at the Coon Creek Demonstration Project, SCS-Wis-1, Coon Valley, Wisconsin. U. S. Soil Conserv. Serv., SCS-TP-46, 4 pp., illus., tables and graphs, Feb. 1942.

Presents hydrologic and land-use data collected by the U. S. Soil Conservation Service during the period 1934-40 at the Coon Creek and Little La Crosse River watersheds. Data are presented on location and history of rain gauges, daily precipitation from all stations, hourly precipitation from all recording gauges, daily maximum and minimum temperatures at La Crosse, Wis., and stream discharge and suspended matter; comparative discharge hydrographs of Coon Creek and Little La Crosse River are included. Suspended matter tabulations show tons of suspended matter per day transported past the gauging stations located on the Little La Crosse River near Leon and on Coon Creek at Coon Valley (April 1934-September 1940).

3. (and Love, S. K.). Hydrologic studies at the South Fork Palouse River Demonstration Project, SCS-Wash-1, Pullman, Washington. U. S. Soil Conserv. Serv., SCS-TP-47, 5 pp., illus., tables and graphs, Feb. 1942.

Presents hydrologic and land-use data collected at the Fourmile Creek, Missouri Flat Creek, and South Fork Palouse River watersheds during the period 1934-40. Data collected are useful for flood-control studies and the design of culverts and bridges. Includes tabulations of suspended matter in tons per day carried past the gauging stations of the three streams.

4. (and Love, S. K.). Hydrologic studies at the High Point Demonstration Project SCS-NC-1, High Point, North Carolina. U. S. Soil Conserv. Serv., SCS-TP-48, 5 pp., illus., tables and graphs, Mar. 1942.

A computation of hydrologic and land-use data collected at the West Fork Deep River, Muddy Creek, and Uharie watersheds during 1934-40. Contains data on measurements made of the suspended load of the West Fork Deep River, Muddy Creek, and Uharie River.

POWELL, J. W.

1. Prevention of floods in the lower Mississippi. *Science*, vol. 12, no. 290, pp. 85-87, Aug. 24, 1888. Deals with flood control on the lower Mississippi River by the prevention of channel choking due to excessive sedimentation on the lowering of the volume of floods by storage above at flood time. Presents results of observed data on the sediment content and sediment discharge of the Mississippi and Missouri Rivers. Conditions of scour and deposit in the streams are briefly described. The effect of storage and irrigation works at headwaters of the Missouri River and other tributaries upon the regulation of the Mississippi is discussed.
2. The laws of hydraulic degradation. *Science*, vol. 12, no. 302, pp. 229-233, Nov. 16, 1888. Discusses the most efficient methods applicable to the control of streams in their flood-plain reaches. Conditions of erosion and the transportation and deposition of material by streams are considered as hydraulic factors involved.
3. Irrigation survey; second annual report. U. S. Geol. Survey, Ann. Rpt. (1889-90) 11, pt. 2, pp. 1-200, illus., 1891.

Reports progress of the irrigation survey conducted by the U. S. Geological Survey, 1889-90. Presents results of observations on sediment and discharge of the Rio Grande at El Paso, Tex., for the period June 1889-September 1890; estimates total silt on the Rio Grande for the year ending June 30, 1890 at 3,830,000 tons.

POWELL, RALPH W. See Vanoni, V. A., 4; Vogel, H. D., 8.

POWELL, WILLIAM JENNER. See Taylor, T. U., 6.

PRANDTL, L.

1. The physics of solids and fluids II. Ed. 2, 392 pp., illus. London, Blackie & Son, Ltd., 1936. Discusses the equilibrium of gases and liquids and the flow of fluids and gases. Comments on the motion of viscous fluid, turbulence, eddy formation, and fluid resistance, etc. Considers the motion of bodies in viscous fluids giving Stokes' formula.

PRATT, J. M.

1. Dredges and dredging in the Mobile District. Prof. Mem., vol. 4, no. 14, pp. 157-198, illus., Mar./Apr. 1912.

Describes the location, physical features, projected dredging work, type of material dredged, and rate of shoaling in the East Pearl River, Wolf and Jordan Rivers, Gulfport Basin and Channel, Ship Island Pass, Biloxi Harbor, Pascagoula Channel, Horn Island Pass, and Mobile Bay in Mississippi.

PREECE, W. H.

1. The navigation of the Nile. *Soc. Arts Jour.*, vol. 53, no. 2724, pp. 274-282, illus., Feb. 3, 1905. Relates to proposed river improvements to aid navigation on the Nile River. Outlines regime of the Nile River and its tributaries, and gives a description of the Aswan Dam. Estimates that 50,000,000 tons of solid matter pass through the dam annually, 20,000,000 tons being utilized as fertilizer while 30,000,000 tons are lost in the sea. Presents details in reference to the effect of erosion, velocity of water, and deposition on suspended silt. Proposes river regulation by removal of shoals, rectification of river

banks, quays in commercial towns, dredging, etc. Points out the possibility of utilizing the natural scouring and polishing action of suspended matter to control silt and improve navigation.

PRESTON, L. S.

1. Irrigation on the Maxwell Grant, New Mexico. Denver Soc. Civ. Engin., Trans., vol. 4, pp. 116-130, illus., 1891.
Deals with the various aspects of irrigation on the Maxwell Grant, N. Mex. Includes a brief discussion on methods employed for silt removal from irrigation canals.

PRESTON, PORTER J. See Mead, E., 4.

PRESTON, SIDNEY. See Griffith, W. M., 1.

PRESTWICH, J.

1. Solvent action of water [extract]. Amer. Jour. Sci., (ser. 3) vol. 4, no. 23, pp. 412-413, Nov. 1872.
Extract from an address by J. Prestwich, Geological Society, London, February 1872 describing results of observations on suspended and dissolved load determinations in the Thames River and its tributaries in the Oolitic and Chalk areas, and on the solvent action of water. Estimated amounts of material removed from these areas due to the solvent action of water are given.

PRICE, W. ARMSTRONG.

1. Geomorphology of depositional surfaces. Amer. Assoc. Petrol. Geol. Bul., vol. 31, no. 10, pp. 1784-1800, illus., Oct. 1947.
Deals with the geomorphology of depositional surfaces such as deltas, deltaic plains, sand dunes, eolian plains, flood plains, terraces, etc. Gives a classification of depositional surfaces. Concludes that extensive mapping of depositional surfaces is needed by the use of 1-5 ft. contours and aerial photographs.

PRICE, W. C. See Coppee, H. St. L., 1.

PRICE, W. G. See Beach, L. H., 1; Grunsky, C. E., 1.

PRINCE, F. S.

1. (and Lyford, W. H.). Progress report, cooperative project on soil erosion, Soil Conservation Service and New Hampshire Agricultural Experiment Station. 41 pp. Durham? N. H., 1938.
Study to determine the source and nature of sedimentary deposits so that prevention can be worked out. Reviews the literature pertaining to sources of sediment, sampling devices, and methods of sampling suspended load. Describes a sampling device which will work for freezing temperatures. Gives results of mechanical and petrographic analysis of sediment deposited by the Connecticut and Merrimack Rivers at times of flood. Conclusions are given.

PROCTOR, CARLTON S. See Campbell, F. B., 1.

PUNJAB IRRIGATION RESEARCH INSTITUTE, LAHORE.

1. Report for year ending April, 1935. 74 pp., illus. Lahore, 1935.
Reports research and observations by the various sections of the Punjab Irrigation Research Institute for the year ending April 1935. Includes summaries of studies dealing with the transmission constant of silts, problems of the movement of silt and the regime of channels, silt curves of canals, the hydraulic significance of silt-curve types, the analysis of hydraulic data, and silting in the Upper Bari Doab Canal.
2. Report for the year ending April, 1936. 73 pp., illus. Lahore, 1936.
Presents results of various observations and experiments conducted by the Punjab Irrigation Research Institute for the year ending April 1936. Includes data on determination of position of filament of mean velocity in canal cross-section and on silt movement and design of channels.
3. Punjab practice in silt observations. Punjab Irrig. Res. Inst., Res. Pub., vol. 2, no. 15, 13 pp., illus., Feb. 1936.
Describes methods of silt investigation in use in the Irrigation Research Institute, Lahore. Gives Punjab methods for dealing with bed silts and silts in suspension. Gives design of apparatus used in taking bed samples. This sampler consists of an eccentrically mounted scoop which digs into the bed when revolved and a cowl which protects the sample from being washed away. Includes a design for a silt bottle sampler.

4. Report for the year ending April, 1937. 228 pp., illus. Lahore, 1937.

Describes progress of work by the various sections of the Punjab Irrigation Research Institute. Describes work done in connection with problems of silt movement and the design of channels, regime relationships, statistical analysis of data pertaining to silt movement as applied to the design of regime channels, analysis of data relative to silt entry into canals as affected by supply and regulation at headworks, silting in canals, model studies on silt exclusion from canals, and chemical analyses of river silts.

5. Summary of the annual report...for the period ending April 1937. India. Cent. Bd. Irrig. Pub. 16, pp. 7-14, 1938.

Discusses results of experiments to determine the effect of temperature and silt content on discharge measurements by a rectangular weir and by a velocity meter. Considers problems of silt movement and design of channels. Results of the chemical analysis of river silt are given.

6. Report for the year ending April, 1938. 156 pp., illus. Lahore, 1939.

The report of the Hydraulic Section, (pp. 89-114), describes and presents results of experiments on silt exclusion (model of Trimmu Weir) and on straightening the approach of the River Sutlej above the Islam headworks. The report of the Statistical Section gives results of investigations relative to the distribution of silt in suspension between a channel and its off-takes. Viscosity as a factor in the flow of water in open channels is discussed. Data for regime slopes for the Haveli project are given. Work of the section in connection with silt movement as applied to the design of regime channels and silt entry into canals as affected by supply and headwork regulation is described.

PUNJAB PUBLIC WORKS DEPT. IRRIGATION BRANCH.

1. Remodelling of the headworks of the Lower Chenab Canal at Khanki. Punjab Pub. Works Dept., Irrig. Branch Papers 23, 83 pp., illus., Apr. 7, 1921.
Discusses the remodelling of the headworks of the Lower Chenab Canal at Khanki, India, in order to insure adequate silt control at the canal head.

PURDY, ROSS C.

1. Qualities of clays suitable for making paving bricks. Ill. Geol. Survey, Bul. no. 9, pp. 133-278, illus., 1908.
Gives the qualities of clays for making bricks, and presents the fineness factor or surface factor for describing the texture of ceramic materials and clays. By multiplying the reciprocal of the mid-point of each grade size by weight percentage which is given as a decimal part of total frequency, the resulting product is the fineness factor.

PURI, AMAR NATH.

1. (and Keen, Bernard A.). The dispersion of soil in water under various conditions. Jour. Agr. Sci. [London], vol. 15, pt. 2, pp. 147-161, illus., Apr. 1925.
An investigation to obtain comparative information on the ease with which soils could be dispersed in water. Describes the technique used in the study.
2. A new method of dispersing soils for mechanical analysis. India Dept. Agr., Mem., Chem. Ser., vol. 10, no. 8, pp. 209-220, Dec. 1929.
Outlines a method of soil dispersion which has the advantages of the International method without the destruction of soil constituents. Notes that NaOH and LiOH are more powerful dispersing agents than ammonia.
3. A new type of hydrometer for the mechanical analysis of soils. Soil Sci., vol. 33, no. 4, pp. 241-248, illus., Apr. 1932.
Discusses a modified type of hydrometer which is an attempt to develop an instrument of precision for mechanical analysis of soils. The results obtained agree closely with those obtained by the standard pipette method.
4. A sensitive hydrometer for estimating total solids in irrigation waters and soil extracts. Soil Sci., vol. 36, no. 4, pp. 297-301, Oct. 1933.

Describes two sensitive hydrometers, one for laboratory use and the other for field work, in determining the percentage of total solids in soil extracts and irrigation waters. The field hydrometer has been used for finding the silt content of canal and river waters, especially during floods.

5. A siltometer for study size distribution of silts and sands. Punjab Irrig. Res. Inst., Res. Pub., vol. 2, no. 7, 6 pp., illus., Nov. 1934.

Describes a simple type of siltometer which has been devised to study the size distribution of sands and silts.

6. The ammonium carbonate method of dispersing soils for mechanical analysis. Soil Sci., vol. 39, no. 4, pp. 263-270, tables, Apr. 1935.

Gives a detailed description of the ammonium carbonate method of dispersing soils for mechanical analysis.

7. (and Puri, B. R.). Physical characteristics of soils; IV. Density gradients in sedimenting columns and a chaino-hydrometer for mechanical analysis of soils. Soil Sci., vol. 48, no. 2, pp. 149-159, Aug. 1939.

Examines the density gradients in suspensions of 150 soils and gives results of observations. Discusses the use of a chaino-hydrometer of high sensitivity in the mechanical analysis of soils.

PURI, B. R. See Puri, A. N., 7.

PURVES, R. E. See Griffith, W. M., 1.

PUTMAN, J. A.

1. (and Bermel, K. J., and Johnson, J. W.). Suspended-matter sampling and current observations in the vicinity of Hunters Point, San Francisco Bay. Amer. Geophys. Union, Trans., vol. 28, no. 5, pp. 742-743, illus., Oct. 1947.

Treats observations made on suspended-matter concentration, bottom-material composition, and current velocity and direction at Hunter Point in San Francisco Bay. Gives a table showing the variation of suspended-matter concentration with stage and depth of tide.

PUTZINGER, JOSEF.

1. Das Ausgleichgefälle Geschiebeführender Wasserläufe und Flüsse (Gradient equalization in rivers and channels transporting bed load). Oesterr. Ingen. u. Architekten Verein, Ztschr., vol. 13, pp. 119-123, Mar. 28, 1919. In German. Translation on file at the U. S. Soil Conservation Service, Washington, D. C.

Discusses slope as a function of local bed-load size and the intensity of shear stress. Includes equations on shear stress and the longitudinal profile line. Gives various other equations.

PYE, MARGARET HURST. See Pye, W. D., 1.

PYE, WILLARD D.

1. (and Pye, Margaret Hurst). Sphericity determinations of pebbles and sand grains. Jour. Sedimentary Petrology, vol. 13, no. 1, pp. 28-34, tables and graphs, Apr. 1943.

Determines the sphericity of sand grains and pebbles by taking ratios of the diameters of the particles. A comparison of this method and the method used by Wadell shows that they give essentially the same results.

2. Rapid methods of making sedimentational analyses of arenaceous sediments. Jour. Sedimentary Petrology, vol. 13, no. 3, pp. 85-104, illus., tables and graphs, Dec. 1943.

Describes new methods developed which use the projected image of sandstone grains for determinations of size, shape, and roundness. Presents short cuts and other methods of analysis.

PYERITZ, H. W.

1. (and Bryan R. P.). Comprehensive program is started to prevent soil erosion and provide flood control. West. Construct. News, vol. 10, no. 3, pp. 72-74, illus., Mar. 1935.
Considers the soil erosion prevention and flood control program in the Western States. More than 35,000,000 acres of fertile land are subject to erosion. The Mississippi River annually transports 400,000,000 tons of soil to the Gulf. Oraibi Wash, once a mild intermittent stream, is now a sinister gully 20-80 ft. deep and 80

miles long, carrying silt to the Colorado River. Restoration of natural vegetation, construction of check dams, brush dams, and jetties to control erosion and collect silt, are recommended. San Carlos Reservoir at the \$5,000,000 Coolidge Dam is being rapidly silted and silt is damaging the adjacent irrigation system. Discusses flood and erosion control measures.

2. (and Bryan, R. P.). Removing the kinks from the Rio Grande and reducing its flood menace. West. Construct. News, vol. 10, no. 5, pp. 121-123, illus., May 1935.

Considers the improvement of the Rio Grande by channel straightening and construction of a flood-control dam. Flood condition are serious because of numerous arroyos. In the El Paso-Jaurez Valley, silt deposits have raised the river bed 12 ft. since 1907. Estimates 72 acre-feet of silt per year per 100 sq. miles of watershed. Elephant Butte Dam aggravates the conditions. Before the dam was built, floods distributed silt over a long section of the river. Since completion of the dam, the maximum flow from dam is less, and arroyos continue to bring silt to the river below the dam, resulting in silt deposition in the river bed. Silting in the rectified channel is to be prevented by increased velocity due to increased gradient. Shows plans for Caballo Dam.

PYLE, FRED D.

1. (and Thomas, Franklin). Report on the silt problem—Progress report of Special Committee on Irrigation Hydraulics. Amer. Soc. Civ. Engin., Proc., vol. 51, no. 3, pp. 141-144, 151-153, Mar. 1925.

Discusses tabular data on the silt load of the Colorado River, Yuma, Ariz., and siltation of the Elephant Butte Reservoir on the Rio Grande; volume-weight determinations of deposited Colorado, Gila, and Rio Grande silt; quantity of silt carried by streams; and silt exclusion from irrigation works; the quantity of silt entering the Imperial irrigation canals (1912-23); the removal of deposited silt from irrigation canals; the estimated total quantity of silt deposited on lands in the Imperial Valley in 1923; cross-sectional distribution of silt in the Alamo Canal; extent of silt removal by erosion from canals of the Carey Act Project, Valier, Mont.; and hydraulic properties in canal design to economically dispose of transported silt. An annotated bibliography on subjects bearing on silt problems selected for research by the Special Committee on Irrigation Hydraulics is included.

QUINN, JAMES B.

1. Inspection of the improvement of the South Pass of the Mississippi River. U. S. Engin. Bur., Ann. Rpt., (1894) pt. 3, pp. 1333-1347, illus., 1894.
Presents results of surveys and improvements to the South Pass of the Mississippi River for the year 1894. Presents summarized data on velocity, sediment, and discharge observations, (1879-93).

QUIRKE, TERENCE T.

1. Velocity and load of stream. Jour. Geol., vol. 53, no. 2, pp. 125-132, Mar. 1945.
Notes that geology textbooks confuse power with the force of a stream. Discusses the need to distinguish between the capacity of a stream to transport a load and its competency to move masses of specific size, and also to distinguish between Gilbert's definition of capacity and its potential energy. Notes errors made by writers when they relate capacity of a stream to its velocity and use empirical formulas based on flume experiments for stream phenomena. Comments on the use of Chezy's formula in dealing with velocity.

QURAIISHY, MOHAMED SALEH.

1. River meandering and the earth's rotation. Current Sci., vol. 12, no. 10, p. 278, Oct. 1943.

Discusses the effect of the earth's rotation on river meanders known as Baer's Law or Coriolis' Effect. If model experiments are a clue to large-scale phenomena, then conclusions drawn are against terrestrial rotation as a cause of meanders. Hydraulic experiments show that predominance of curves to the right or left is a chance phenomenon.

2. The critical shear stress. *Bombay Univ. Jour.* (n. s.), vol. 12, pt. 3, sect. A, pp. 37-46, illus., Nov. 1943.

Propounds a theory of the transport of sediment by flowing water by supposing that when in motion, the force impressed upon a sand layer by flowing water on the moving fluid is proportional to the force exerted on the particles by their own weight as when falling freely in a stationary fluid column.
 3. The calculation of the critical shear stresses and the sediment sizes [letter to editor]. *Current Sci.*, vol. 12, no. 12, pp. 333-334, Dec. 1943.

Notes that the writer has recently worked out a theoretical solution of critical shear stress. Suggests a procedure for estimating particle size.
 4. The origin of curves in rivers. *Current Sci.*, vol. 13, no. 2, pp. 36-39, illus., Feb. 1944.

Reviews various hypotheses purporting to explain the origin of curves in rivers. Gives a short account of how the curves are created. The experiments were performed in a flume. Tests led to the conclusion that skew shoots are responsible for the origin of curves in rivers.
- RAMDACHER, F. M.**
1. Cross currents in channels. *Military Engin.*, vol. 27, no. 155, pp. 341-342, illus., Sept./Oct. 1935.

Discusses model studies of deposition of solid matter in a channel dredged through open water in which tidal currents passed over the channel at 45°. The model was on a vertical scale of 1:190 and a horizontal scale of 1:5,280. Crushed soft coal and pellets of blotting paper were used to observe the direction of the current flow, as well as deposition and motion in the channel. The same location and configuration of deposits were observed in the model as actually occurred in the prototype. The model verified the fact that a component of velocity acted along the channel to move deposits towards shore during the flood tide and to create the shoals actually present in the prototype. Studies were also made with the tidal flow at right angles to the channel and with various depths of the channel.
- RAEBURN, C.**
1. (and Milner, Henry B.). *Alluvial prospecting.* 478 pp., illus. London, T. Murby & Co., 1927.

A handbook on the prospecting of alluvial deposits. Treats of such subjects as classification of alluvial deposits, provenance and association of alluvial minerals, transport and accumulation of alluvium, prospecting methods, geophysical aids, field investigation of alluvial concentrates, and laboratory investigation of alluvial minerals. Gives diagnostic properties of 46 alluvial minerals and 24 rare and local species.
- RALSTON, ROBERT R.**
1. The Plaquemine Lock. *Prof. Mem.*, vol. 4, no. 16, pp. 441-443, illus., July/Aug. 1912.

Describes details of construction and costs of the Plaquemine Lock, La. Includes a discussion on early attempts to improve the bayou at Plaquemine, closure of the channel and efforts to secure a navigable stream by dredging. About 356,000 cu. yd. of material have been removed. A 1912 revised project contemplates the removal of about 1,108,000 more cu. yd., construction of 5 spur dikes, at a cost of \$103,000, failed to provide adequate bank protection. Brush and pole mattresses, costing \$103,000 more, were placed between the spurs. Caving continues and may threaten the lock itself unless protection work is extended up- and downstream.
- RAMIREZ, ENRIQUE.**
1. Protection of river banks with spur dikes [letter to editor]. *Engin. News-Rec.*, vol. 86, no. 21, p. 909, illus., May 26, 1921.

Describes the methods employed to find length of spur dikes, distance between them, and the location with respect to direction of stream for protection of river banks.
- RAMSAY, C. C.** See Roberts, W. J., 1.
- RAMSER, C. E.** See also Jones, L. L., 1; Trullinger, R. W., 1; Anonymous, 100.
1. Progressive erosion in a dredged drainage channel. *Engin. News-Rec.*, vol. 82, no. 18, pp. 876-877, illus., May 1, 1919.

Gives observations on the enlargement of drainage channels, due to erosion by water, and computations of Kutter's n from data obtained on North Forked Deer River drainage channel near Trenton, Tenn. Gives factors favorable to erosion and absence of silting in this channel and notes reports of the investigations by the U. S. Bureau of Public Roads and Rural Engineering on silting and erosion in various channels.
 2. The flow of water in drainage channels with special reference to the results of experiments to determine the roughness coefficient "n" to Kutter's formula. *Iowa Engin. Soc., Proc.*, vol. 36, pp. 19-37, illus., 1924.

Presents results of experiments conducted by the U. S. Department of Agriculture on about 50 drainage channels in the States of Florida, North Carolina, Tennessee, Mississippi, Missouri, Iowa, and Minnesota to determine the n in Kutter's formula. Results of observations on the effects of silt and debris accumulations in channels on the discharge capacity and the frictional resistance to flow are included.
 3. Erosion extends relief channel far beyond its bounds. *Engin. News-Rec.*, vol. 94, no. 10, pp. 391-392, illus., Mar. 5, 1925.

Describes the causes and effects of erosion in the Cape La Croix Creek cut-off channel, Cape Girardeau County, Mo.
 4. Erosion and silting of dredged drainage ditches. *Iowa Engin. Soc., Proc.*, vol. 39, pp. 49-68, illus., 1927; also in *Engin. and Contract.*, vol. 66, no. 2, pp. 71-79, illus., Feb. 1927.

Presents results of measurements and observations made on 23 drainage ditches in the States of Mississippi, Missouri, Tennessee, and Iowa in an investigation of erosion and silting. Data pertaining to changes in the channels due to erosion and silting together with hydraulic elements for the channels are given. Factors that enter into the problem are considered. Discussion: C. H. YOUNG, pp. 69-72, briefly describes corrective measures necessitated by damages due to silting or erosion employed on some drainage projects in Iowa. Describes the effect of silting up of bed of the Mississippi River behind Keokuk Dam upon drainage and flood conditions in the Green Bay drainage district. Proposed projects for the utilization of the silt lands at the mouths of the Maquoketa, Turkey, Upper Iowa, and Root Rivers are also considered.
 5. Results of experiments in central Illinois on the flow of water in drainage ditches for cleared and uncleared conditions of channel. *Ill. Soc. Engin. Rpt.*, vol. 43, pp. 46-54, illus., 1928.

Presents results of experiments conducted by the U. S. Department of Agriculture on 11 drainage ditches and the Embarrass River to determine Kutter's n for use in the design drainage ditches in central Illinois and in computing discharge capacities of existing channels for both cleared and uncleared channel conditions. Results of measurements indicate that the utility of drainage channels is impaired by vegetation, since vegetation reduces velocity permitting deposits of rich silt containing plant seed thereby inducing further vegetative growth.
 6. Flow of water in drainage channels. *U. S. Dept. Agr., Tech. Bul.* 129, 102 pp., illus., Nov. 1929.

Presents a description of experiments and a summarization of results obtained to determine the values of the coefficient of roughness n in Kutter's formula to be applied to various drainage channel conditions. Experiments conducted in Lee, Washington, and Bolivar Counties, Miss., and in West Tennessee, western Iowa, southern South Carolina, eastern Florida, eastern Arkansas, southeastern Missouri and central Illinois. The results of the study indicate, among other things, that silt deposits on sides and bottom of channel reduce frictional

resistance to flow, that accumulations in a channel greatly decrease its capacity, and that after a certain amount of erosion has taken place in a channel, further erosion does not necessarily increase the roughness of the perimeter. Values of n recommended in designing drainage ditches are given.

7. Erosion and silting of dredged drainage ditches. U. S. Dept. Agr., Tech. Bul. 184, 54 pp., illus., June 1930.

Presents results of observations and cross-sectional and hydraulic measurements between 1913 and 1921 on 21 dredged drainage ditches in Mississippi, Tennessee, and Iowa. Discusses the relation of velocity to erosion, the factors influencing velocity, conditions affecting erosion and silting in a channel, and the effect of erosion and silting on discharge capacity of a channel. Data relating to changes in dredged drainage channels are given. Streams in Lee and Bolivar Counties, Miss., in western Tennessee, and in western Iowa are described. Considers the practical application of results to the design of a dredged channel on the Bay Creek watershed in southern Illinois.

8. Dynamics of erosion in controlled channels. Amer. Geophys. Union, Trans., vol. 15, pt. 2, pp. 488-494, illus., June 1934.

Relates to the dynamics of erosion in controlled channels and discusses the erosive power of a stream as a function of velocity, the ability of soils to be transported, and silt transportation in suspension and along the bed of a stream. Gives the relationship of silt-transporting power of a stream to velocity and the depth noting that velocity depends on fall, hydraulic radius of channel, and the roughness factor. Also includes formulae and experimental proof and comments on the value of vegetation in a channel for the reduction of velocity and erosion. Pictures the construction, spacing, and control of terraces as determined from results at the Bethany, Mo., and Guthrie, Okla., erosion-experiment stations.

9. Watershed and hydrologic studies in soil conservation. Agr. Engin., vol. 17, no. 9, pp. 373-376, illus., Sept. 1936.

Describes the U. S. Soil Conservation Service studies on the effects of erosion on lands used to conserve water and control floods, and studies to determine rates and amounts of runoff and eroded soil material. Discusses economic effect of floods and deposition of sediment by floods on fertile bottomlands, in stream channels, drainage ditches. Notes that Austin Dam, Tex., was nearly filled with sediment in 15 yr. Notes the necessity for basic runoff data and field procedure and measurements. Experiment stations are near Coshoc-ton, Ohio, Waco, Tex., and the Great Plains Region, Colo.

RANDOLPH, E. E. See Ray, C. E., Jr., 1.
RAPP, J.

1. Geschiebepbewegung in natuerlichen Wasserlaefen (Bed-load movement in natural watercourses). Wasserkr. u. Wasserwirtsch., vol. 29, no. 2, pp. 13-15, illus., Jan. 16, 1934. In German. Translation on file at the U. S. Soil Conservation Service, Washington, D. C.

Presents results of observations relative to the direction of movement of bed load in straight and curved reaches of the Inn River. Describes observational apparatus, and factors affecting the direction of movement of bed load.

RAPPENECKER, C.

1. A diagrammatic illustration of headward erosion. Tenn. Acad. Sci. Jour., vol. 13, no. 4, pp. 250-252, Oct. 1938.

The mechanism of erosion and gully formation in silt at the head of Parkville Reservoir at Parkville, Tenn., on the Ocoee River below Ducktown Region is discussed and the contrast between erosive effectiveness of the main stream and that of a small spring-fed clear-water tributary is shown. Erosion of the latter shows that the clear water must first pick up a load of silt before it can do serious gully cutting.

RASTALL, R. H. See Hatch, F. H., 1.

RATHBUN, RICHARD.

1. Report upon the inquiry respecting food-fishes and the fishing-grounds. U. S. Comm. of Fish and Fisheries, Ann. Rpt., pt. 17, pp. 97-171, 1889. Presents results of an investigation by the U. S. Fish Commission for the purpose of studying natural features of the Atlantic and Pacific coast regions and of a wide area of freshwater drainage where fish-cultured operations have been undertaken. Notes the effect of silt and mine tailings on fish life in the streams of Colorado, Utah, and Iowa.

RAY, CHARLES E., JR.

1. (and Randolph, E. E.). Preliminary report on the chemical quality of the surface waters of North Carolina with relation to industrial use. N. C. Dept. Conserv. and Devlpmt., Econ. Paper 61, 73 pp., illus., 1928. Results of 174 analyses of surface waters are tabulated in groups according to physiographic sections of the State. Procedures used in making dissolved- and suspended-load determinations are described.

RAY, CYRUS N.

1. Stream bank silts of the Abilene region. Tex. Archeol. and Paleontological Soc. Bul., vol. 16, pp. 117-147, illus., Sept. 1945. Describes stream-bank silts of the Abilene region, Tex., and the study in 1927 of the vertical banks of all streams in this region for evidences of ancient man's occupation. Gives the results of the study.

RAYLEIGH.

1. On the motion of solid bodies through viscous liquid. London, Edinb. and Dublin Phil. Mag. and Jour. Sci., (ser. 6) vol. 21, no. 126, pp. 697-711, June 1911. Gives a mathematical treatment of the motion of solid bodies through viscous liquid.

RAYMOND, THOMAS L.

1. Improvement of the mouth of the Mississippi River. Engin. News, vol. 39, no. 13, pp. 203-205, illus., Mar. 31, 1898.

Reviews suggested and tried methods of improvement of navigation to the entrance to the Mississippi River. Gives detailed characteristics of the jetty system and possibilities of its application to every major pass of the delta. The regular theories of fluvial hydraulics are taken as a basis of discussion. The rate of advance is discussed.

READE, MELLARD T.

1. Denudation of the two Americas. Amer. Jour. Sci. (ser. 3) vol. 29, no. 172, pp. 290-300, Apr. 1885. Presents calculations dealing with the amount of matter annually removed by streams from some of the larger river basins of North and South America and inferences and generalizations with reference to conditions of denudation. Data are given for the Mississippi River, Rio de La Plata, St. Lawrence and Amazon Rivers. Dissolved- and suspended-load determinations and rates of land-surface reduction are considered.

REAGAN, ALBERT B.

1. Geology of Monroe County, Indiana. Ind. Acad. Sci., Proc., pp. 205-233, illus., 1903. Deals with the geology of Monroe County, Ind., and considers in connection with post-glacial deposits, the development of alluvial plains and alluvial fan deposits in the Bean Blossom Creek Valley, the growth of young valleys, reversal of tributary drainage and changes in tributary channels due to aggradation of Bean Blossom Creek, abandoned channels now filled with glacial sand, and wind gap formation due to degrading action of small streams on opposite sides of the divide. With relation to the post-glacial history of Bean Blossom Creek, conditions of meandering and aggradation are briefly discussed. Notes that the creek tends toward the south bank due to accumulations of debris at mouths of tributaries in the northside of the valley.
2. Recent changes in the plateau region. Science n. s., vol. 60, no. 1552, pp. 283-285, Sept. 26, 1924. Describes historically, conditions of aggradation and degradation in the plateau region southeast of the Colorado River. In the past,

intensive farming, irrigation, and storage works together with little grazing, caused streams to fill up with detritus and aggrade valleys. At present overgrazing with lack of water storage is the chief cause of valley degradation. Describes in detail conditions existing in Segi Canyon region 174 miles northeast of Flagstaff, Ariz., and points out that change in climate condition is not the cause of arroyo cutting.

3. Stream aggradation through irrigation. Pan-Amer. Geol., vol. 42, pp. 335-344, Dec. 1924.

Discusses stream aggradation resulting from water conservation practiced by the Indians in Arizona. Check and irrigation dams of the ancient Indians retarded runoff, causing deposit of debris on fields and in fans over valleys, the lack of running water in channels causes them to fill. Farming and stock raising by the white man and Navajos have reversed the process and encouraged cutting of canyons and permanent channels by unchecked flood waters.

REAGAN, J. W.

1. The Los Angeles County Flood Control District. West. Construct. News, vol. 1, no. 16, pp. 32-41, illus., Aug. 1926.

Discusses the dams contemplated and under construction in the Los Angeles County Flood Control District, Calif., including five short paragraphs on debris brought down near the Pacoima dam-site, in the San Gabriel River and other similar canyons. The use of check dams is considered a more or less temporary expedient requiring high maintenance and replacement cost.

RECLAMATION SERVICE. See U. S. Bureau of Reclamation; U. S. Reclamation Service.

RED CROSS. U. S. AMERICAN NATION RED CROSS. BOARD OF ENGINEERS.

1. Report...on the Huai River conservancy project in the provinces of Kiangsu and Anhui, China. 28 pp., illus. Washington, 1914.

Considers the physical conditions affecting the project and governing the feasibility of the project, public lands which can be reclaimed, private lands which can be improved, and cost, etc. of proposed regulation and reclamation works, and presents hydrologic data. Describes conditions of the Yellow River. Notes laws of delta growth.

2. The Huai River conservancy project [extract]. Prof. Mem., vol. 7, no. 31, pp. 113-120, illus., Jan./Feb. 1915.

Extract from technical report of the Board of Engineers appointed by the American National Red Cross on the Huai River Conservancy Project. Notes that Huai River drainage basin was gradually filled by deposits brought down from surrounding mountains by numerous streams. Historical evidence indicates that the Yellow River has been diked for 4,000 yr. and has not created, on any course, a gradient sufficient for normal silt transportation. Yellow River, between primitive dikes, has been building up a restricted delta and endeavoring to create a gradient commensurate with its needs by raising its bed and its limited flood plain. Rise of bed resulted in frequent breaks through dikes devastating country, forming new courses and carrying on its work of delta building until confined to restricted course. Discusses laws of delta growth and describes normal growth of Yangtse Delta. Notes that normal delta gradient is a function of the quantity and quality of silt carried by the stream and of the nature of the bed over which the stream flows.

Discussion: C. M. TOWNSEND, (Prof. Mem., vol. 7, no. 32, pp. 181-190, Mar./Apr. 1915), in The Effect of Levees on the Flow of Sediment in Rivers, points out that the report can be construed by those unfamiliar with the principles of river hydraulics as condemnatory of levee construction on other rivers. Discusses the effect of levees on flow of sediment in various rivers of the world. Notes that levees tend to lower rather than elevate any river channel and nothing in the history of the Yellow River levee construction should cause apprehension to the advocates of a levee system on the Mis-

issippi. WILLIAM L. SIBERT, (Prof. Mem., vol. 7, no. 33, pp. 395-400, May/June 1915), in The Rise of the Bed of the Yellow River by the Deposit of Sediment, discusses the question of the discharge of the Yellow River relative to sediment deposition in stream channels due to frequent changes in river outlets. Notes that observations show the rise in the bed of the Yellow River is probably due to insufficient slope in the plain crossed by the river. Conditions of deposition in abandoned stream beds of the Mississippi, Colorado and Yellow Rivers, possibly due to sudden increases in stream length when confining dikes are breached, are discussed. HENRY M. EAKIN, (Prof. Mem., vol. 8, no. 41, pp. 653-665, Sept./Oct. 1916), in Physiographic Principles Manifest in the History of Attempted Control of the Yellow and Mississippi Rivers, attempts to prevent those unfamiliar with the principles of river hydraulics from construing the report as being condemnatory of levee construction on other rivers. Makes various comments on C. M. Townsend's discussion. Points out that denudation of large areas in the Mississippi watershed by agriculture and deforestation destroys the equilibrium between scour and fill of the river, and Mississippi grades will be steepened by erosion of these areas. Reviews channel and river mechanics of the Yellow and Mississippi Rivers. States that data on the Yellow River cannot offer a basis for conclusions in regard to Mississippi factors of increased load from soil erosion. Levee prevention of flood-plain deposition and revetment and prevention of cut-offs will steepen grades in lower reaches of the river, raise the stream bed, increase drainage distance, and affect the required height of the levees. Average cross section surveys from the Arkansas River to Donaldsonville show increasing river sinuosity with prevention of cut-offs. Discusses the value of low-water measurements as an indication of vertical channel stability. States that Townsend's positive conclusion that the Mississippi is not raising its channel is not warranted. C. M. TOWNSEND, pp. 665-675, disagrees with Eakin's description of the cycle of events which form a delta, and gives causes and description of the cycle of delta formation. Cites examples of European rivers having deltas to demonstrate that within a period of 100 yr. there is no evidence of the rise of the river's bed as a result of levee construction. Refutes Mr. Eakin's and other levee opponents' contentions that river beds rise with levees, by showing that gauges on the Mississippi indicate a lowering rather than a raising of the river bed. States that deforestation and soil drainage have no effect on flow or deterioration of stream channels. Depicts similarity of conditions on the Yellow River with those on the Missouri which affords no evidence of a rise of its bed. Claims that the report of a rise in the bed of the Yellow River is erroneous because of the cursory nature of the examinations.

REDDEN, R. E. See Grover, N. C., 12.

REDDICK, HARRY E.

1. Erosion control for reservoir protection. Soil Conserv., vol. 7, no. 3, pp. 77-79, illus., Sept. 1941.

Describes the erosion control program of the U. S. Soil Conservation Service and the East Bay Municipal Utility District, Calif., for the protection of reservoirs in the district. Gives a brief description of the watersheds of the district, land use, and conditions of erosion. Notes that the survey in 1939 of the San Pablo Reservoir revealed that 2.63 percent of the reservoir capacity has been destroyed by sediment accumulations during the 21 yr. of operation. Sources of reservoir sediment and factors causing its movement are noted.

REDWAY, JACQUES W.

1. The dust of the Gobi. Ecology, vol. 2, no. 1, pp. 21-25, Jan. 1921.

Discusses geological and physiographical characteristics of Chinese rivers which flow into the Yellow Sea, wind and water erosion, trans-

REDWAY, JACQUES W. - Continued

portation of erosional material by the Hoang, Yangtze, and Wei Rivers, the deposition of sediments, nature and extent of loess deposits, history of primitive improvements, adjustments of stream velocity to maximum load of silt which the stream transports (Ta-yu), reforestation and protective vegetation for flood control, and fertility of fresh soil deposited on plains by Hoang River.

REE, W. O.

1. (and Palmer, V. J.). Flow of water in channels protected by vegetative linings. U. S. Dept. Agr., Tech. Bul. 967, 115 pp., illus., Feb. 1949.

Deals with extended research conducted by the U. S. Soil Conservation Service in South Carolina on the characteristics of various plants for use for the lining of channels. The plant cover and roots protect the channels from erosive action and hinder bed movement.

REED, C. E. See Hauser, E. A., 1.

REED, OREN. See also Taylor, T. U., 6.

1. Swiss methods of avoiding silt deposits in reservoirs. Engin. News-Rec., vol. 107, no. 8, pp. 289-290, illus., Aug. 20, 1931.

Discusses the Swiss methods of preventing silt deposition in reservoirs. Note is made of silt transporting power of running water, sizes of particles at source and mouth of stream, distribution of silt in reservoirs and construction of bank and bottom revetments to decrease silt load of streams. Amsteg Reservoir on Reuss River, Switzerland, is equipped with cyclopean masonry weir which diverts flow of heavily silt-laden flood waters into a bypass tunnel permitting clear water to enter the reservoir. Estimated quantity of debris bypassed annually is more than 130,000 cu. yd. (concentrated in about 3 mo.). Abrasive action of silt on bypass tunnel is described. At Waeggital project, Switzerland, the Rempen Dam is located on the Aa River above the junction with Trebsen Brook which is heavily silt laden and its water must be clarified by the use of a diversion weir before it can be diverted into the Rempen Reservoir.

REED, R. D.

1. [Review of] The examination of fragmental rocks, by F. G. Tickell. Jour. Sedimentary Petrology, vol. 1, no. 2, pp. 100-101, Nov. 1931.
Gives a description of the book (Tickell, F. G., 1). Discusses the various chapters and contents of the book, which is concerned with such subjects as mechanical analysis, porosity and permeability, preparation of specimens for microscopic study, identification of minerals, and optical properties of the more important detrital minerals.

REED, W. M.

1. Operations in New Mexico. U. S. Reclam. Serv., Ann. Rpt., 3, pp. 360-431, illus., 1905.
Reports activities of the U. S. Reclamation Service in New Mexico. The method of determining the amount of silt deposited in Lake McMillan Reservoir is described, the results indicate reduction of 42 percent of the original capacity in 10 yr. Silt content of samples of water from the Pecos River above the reservoir ranged from 36 to 563 pt. in 100,000 pt. of water. Percentages of silt found in Rio Grande water at El Paso are tabulated. Results of studies of proposed reservoirs at El Paso, Tex., and at Engle, N. Mex., are given and discussed. Estimates that in 46 yr. El Paso Reservoir will lose 60 percent of capacity by silting and Engle Reservoir will lose 60 percent of its capacity in 82 yr. The possibility of removing silt deposits from both reservoirs by sluicing is discussed.
2. Silting of reservoirs. U. S. Geol. Survey, Water-Supply Paper 146, pp. 126-128, 1905.
Deals with the matter of silt deposit in storage reservoirs. Survey made at Lake McMillan, principal storage reservoir of the Pecos Irrigation Co., N. Mex., shows the original capacity to have been 28,732 acre-feet, and its capacity June 1, 1904, to be 16,500 acre-feet, or a loss of storage capacity, in 10 yr., of about 42 percent. The flow of the river averages 10 times

the capacity of the reservoir indicating that small reservoirs on streams of great flow have a very low ultimate of efficiency. Conditions of deposit outside the storage area of the reservoir and possible methods of desilting are briefly examined. Notes that sediment in the Pecos amounts to 180 pt. of suspended matter to 100,000 pt. of water, and in the Rio Grande 831 pt. per 100,000.

REHBOCK, THEODOR.

1. The river-hydraulic laboratory of the Technical University at Karlsruhe. In Freeman, John R., ed. Hydraulic laboratory practice, pp. 111-244, illus. New York, Amer. Soc. Mech. Engin., 1929.

Describes and gives the work of the river-hydraulic laboratory of the Technical University at Karlsruhe, Germany. Treats of a study of the distribution of sediment in stream diversions on the middle Isar and notes the distribution of sedimentary material in a branching channel for different values of the angle of diversion.

REICHE, PARRY.

1. A survey of weathering processes and products. N. Mex. Univ. Pub. Geol., no. 1, 87 pp., illus., 1945.

Describes various ways by which rocks are destroyed and sediments produced and reviews the weathering processes and products of weathering. Considers the importance of chemical weathering and includes a chapter on soil formation.

REICHSTEIN, AMIEL.

1. Soil conservation helps to protect water supply. Pub. Works, vol. 72, no. 12, pp. 33-35, illus., Dec. 1941.

Describes the work of the U. S. Soil Conservation Service in cooperation with the farmers on the drainage areas of the three water-supply reservoirs of the city of Fairfield, Iowa, in the erection of erosion control structures to protect the city's water supply. Work consisted of building terraces, planting trees, and building structures to create desilting basins. Surveys in 1934 indicate that Reservoir No. 1, constructed in 1884 with an original capacity of 60 m.g. still had between 55 and 57 m. g., Reservoir No. 2 constructed in 1900 and raised in 1911 showed a decrease of 15 percent in storage capacity in 23 yr., Reservoir No. 3 constructed in 1924 lost 20 percent of its capacity in 10 yr.

REID, A. G.

1. Silting operations—On the strengthening of the banks of water-bearing channels by silting. Punjab Pub. Works Dept., Irrig. Branch Papers 5, pp. 1-14, illus., Mar. 30, 1894.
Deals with the utilization of silt for the strengthening, in an economical manner, of the banks of water-bearing channels. Gives circumstances under which the strengthening of banks should be contemplated and methods of strengthening canal banks through the agency of silting.
2. Apparatus for observations on the Sirhind Canal. Punjab Pub. Works Dept., Irrig. Branch Papers 3, 4 pp., illus., Mar. 1913.
Presents detailed data on design, costs, etc. of the apparatus for silt observations to be conducted on the Sirhind Canal.

REID, B. M. See Burton, E. F., 1.

REID, HERBERT C.

1. Relative advantages of dredging and training walls in estuaries [abstract]. Engin. and Contract., vol. 56, no. 22, pp. 507-508, Nov. 30, 1921.
Gives relative advantages of dredging and training walls in estuaries and notes the need for study of the character of the bar, the sea outside the bar, tides, nature of sediment, and prevailing winds. Kennedy's principle for scour is taken as the foundation of discussion. Outlines the advantages and disadvantages of suction-dredging plants and training works and calls attention to the economic aspects of the problem.

REID, J. S. See also Brown, G. A. M., 1; Inglis, C. C., 23, 25-33, 36, 44-45, 47-49, 53, 56, 60, 63-65, 70, 72.

1. Lacey & Kennedy. India Cent. Bd. Irrig., Pub. 31, pp. 61-64, illus., 1944.

Shows how sections and slopes similar to Lacey's can be evolved from V/Vo and Kutter. Deals with shape and attempts to explain some of the factors affecting it, and indicates that Lacey's sections, and the "optimum" ones described in the report have to be modified by channel velocities. Gives a convenient way of working out the minimum slope required in a lined channel which has to carry silt sand.

REID, KENNETH A.

1. Pollution of streams from mining operations. North Amer. Wildlife Conf., Trans. n. s., vol. 1, pp. 544-550, illus., 1936.

Discusses the problems of stream pollution resulting from mining operations and describes the means for their solution. Notes effects of mining operations in eastern Pennsylvania upon conditions of culm deposition in streams and effect of deposits on aquatic life.

REINECKE, LEOPOLD.

1. Average regional slope, a criterion for the subdivision of old erosion surfaces. Jour. Geol., vol. 24, no. 1, pp. 27-46, illus., Jan./Feb. 1916.

Discusses writer's objections to the subdivision of old erosion surfaces by the use, as a criterion, of the average regional slope. Includes a discussion on the rate at which a land form is worn down by mechanical erosion, and notes the results of Gilbert's experiments on the relations between the load of debris that a stream can transport along its bed and its slope.

REINECKE, PAUL S. See Vogel, H. D., 9.

RENNER, F. G.

1. Conditions influencing erosion on the Boise River watershed. U. S. Dept. Agr., Tech. Bul. 528, 32 pp., illus., Oct. 1936.

Presents results of a survey on the relative importance of factors influencing erosion on the Boise River watershed and discusses the necessity of restoring plant cover and initiating improvements in range and livestock management. Notes that silt deposits amounting to 7,500 acre-feet in Arrowrock Reservoir, 1915-27, silting in the millpond at Barber, Idaho and the excessive silt deposits in the Boise River are evidence of accelerated erosion. The economic aspects involved are discussed.

RENNIE, SIR JOHN.

1. On the ancient harbour of Ostia. Inst. Civ. Engin., Minutes of Proc., vol. 4, pp. 307-319, 1845.

Describes the geographical and geological features of the valley of the River Tiber. Discusses the bar at the mouth of the Tiber and means for removing the bar. Notes means adopted to render the Tiber navigable from its mouth to Rome.

Discussion: F. GILES, pp. 320-323, describes the results of improvements made to various harbors in England, France, and Italy for purposes of utilizing the action of tides and of rivers for the scouring away of sand and silt accumulations.

REVVY, G. VICTOR.

1. The protection of river-banks [abstract]. Inst. Civ. Engin., Minutes of Proc., vol. 104, pp. 341-343, 1890.

Describes conditions of bank erosion on the Rivers Theiss and Bodrog, Hungary, and the nature and design of river-bank protective works.

REYER, A.

1. The Suez Canal [extract]. Engineering, vol. 8, p. 145, Aug. 27, 1869.

Extract from a letter to the editor of the Grazer Tagespost on the difficulties to be overcome to render the Suez Canal navigable. Notes the danger of silting up of harbor of Port Said by fine deposits brought down by the Nile, also choking up of the Suez Canal by sand storms and washings from the sides.

REYNOLDS, OSBORNE.

1. On certain laws relating to the régime of rivers and estuaries, and on the possibility of experiments on a small scale. Brit. Assoc. Adv. Sci., Rpt. 57, pp. 555-562, 1888.

Presents results and conclusions in regard to the action of flowing water in the arrangement of granular materials. Discusses the régime of

rivers, movement of sand, uniform drift, and movement of water and its effect on granular material. Considers the use of models.

RHODES, RALPH F. See Hathaway, G. A., 1.

RICH, J. D.

1. Piedmont stream capture as a result of difference in load [abstract]. Geol. Soc. Amer., Bul., vol. 49, no. 12, pp. 1941-1942, Dec. 1, 1938.

Abstract of a paper presented before Section E of the American Association for the Advancement of Science, June 1938. Contains a description of the process of stream capture due to differences in stream loads as illustrated by conditions in the Beartooth Mountains, Mont., where Grove Creek is about to be captured by a small tributary.

RICH, JOHN LYON.

1. Recent stream trenching in the semi-arid portion of southwestern New Mexico, a result of removal of vegetation cover. Amer. Jour. Sci., (ser. 4) vol. 32, no. 190, pp. 237-245, illus., Oct. 1911.

Describes the nature of recent stream trenching in the semi-arid portion of southwestern New Mexico and gives evidence that this condition is a result of the removal of vegetative cover. Gives a description and history of Cane Springs Canyon as a typical valley and discusses the features and conditions of the valley filling. Notes that existence of coarse stream gravel overlying finer alluvial matter in the bottom of trenches indicates that its deposition is recent and due to increased volume of flood waters. Increased volume of flood waters is a result of increased runoff due to the removal of vegetative cover brought about by overstocking. Cites historical evidence that the reduction in cover as a result of overstocking has taken place and flood increases coincident with trench formation are of recent date.

Discussion: F. S. DELLENBAUGH, (Science n. s., vol. 35, no. 904, pp. 656-658, Apr. 26, 1912), notes that removal of vegetation cover is not the cause of, but may accelerate, retrograding of stream beds. Cross cutting and retrograding of stream beds are given as the chief causes of degradation in any region. Describes the process with its subsequent bank caving, and illustrates with examples in southern Utah.

2. Certain types of stream valleys and their meandering. Jour. Geol., vol. 22, no. 5, pp. 469-497, illus., July/Aug. 1914.

Gives an analysis of the work of a river in carving its valley. Notes the controlling factors determining the dominant process. Comments on the open valley, the entrenched valley, and the in-grown valley and notes the effects of the uplift of a drainage basin on the form of a valley. Presents specific application of the criteria.

RICHARDS, H. DE C. See Harts, W. W., 2.

RICHARDS, ROBERT HALLOWELL.

1. (and Woodward, A. E.). The velocity of bodies of different specific gravity falling in water. Amer. Inst. Mining Engin., Trans. (1889-90), vol. 18, pp. 644-648, illus., 1890.

Presents curves for the velocity of fall in water of bodies of different specific gravity, giving for each specific gravity the relation of diameter of particle to its velocity of fall.

2. Velocity of galena and quartz falling in water. Amer. Inst. Mining Engin., Trans., vol. 38, pp. 210-235, tables, 1908.

Consists of a study of the settling velocities of galena and quartz in water. Points out that two different laws govern the settling of particles depending upon whether the velocity is above or below a certain critical or transition point. Gives the formula for the law of the velocities below the critical points and notes that above the critical velocity the law is expressed by Ritinger's formula.

3. (and Locke, Charles E.). Textbook of ore dressing. Ed. 3. 608 pp., illus. New York, McGraw-Hill Book Co., Inc., 1940.

Treats the theory, principles, and practice of ore dressing. Contains a chapter which describes sizing by screens, giving a sieve scale for the Tyler standard testing sieves. Includes a chapter on the classifying and settling in water which considers free and hindered set-

ting of particles. Gives a table of free settling velocities for quartz and galena. Points out that two different laws operate for settling of particles depending on whether or not the velocity is below or above a certain critical point. The formula of Rittinger can be used for velocities above the critical point and another formula is used for velocities below. Rittinger's formula with the proper coefficients can be used to determine the hindered settling velocities of quartz and galena.

RICHARDSON, A. H. See Bates, C. G., 6.
RICHARDSON, E. G.

1. (and Tyler, E.). The flow of liquid suspensions. [London] Phys. Soc. Proc., vol. 45, pt. 2, no. 247, pp. 142-151, illus., Mar. 1933.
Considers the use of a hot-wire anemometer for measurements of the velocity from point to point in a liquid rotating in the space between two concentric cylinders. Shows that in a suspension, the velocity-gradients are abnormal but can be explained in terms of a variable viscosity which is a function of the velocity-gradient.
2. The transport of silt by a stream. Phil. Mag. and Jour. Sci., vol. 17, no. 114, pp. 769-783, illus., Apr. 1934.
Presents laboratory experiments on transportation of silt by a stream and describes the author's experiments noting those by Gilbert, Schoklitsch, Krammer, and others. The author's investigations show that transportation of silt is mainly due to turbulence in the stream. Under these conditions the vertical distribution is nearly exponential and the lifting force is proportional to the square of the velocity. Below the critical velocity silt is moved to a much less degree, the movement being confined to the smaller particles in the lower strata of the stream.
3. An optical method for mechanical analysis of soils, etc. Jour. Agr. Sci. [London], vol. 24, pt. 3, pp. 457-468, illus., July 1934.
Describes the results of attempts in using a beam of light passing through a glass cell in order to measure the process of sedimentation taking place within. A photoelectric cell is used to receive the transmitted light. Suggests that optical methods can be applied to the measurement of sediment carried in suspension in streams.
4. Measurements of erosion by water, using electrical methods. Internat. Cong. Soil Sci., Oxford, Trans. 3, vol. 1, pp. 405-407, 1935.
Reports a model study to obtain actual measurements of the quantity of soil carried in suspension at various levels above the bed and at the same time and place to measure the velocity of the stream. Notes that erosion and subsequent transport of soil by streams depend on (1) the velocity gradient in the direction perpendicular to flow, (2) turbulence in the stream, (3) size and specific gravity of soil particles, and (4) configuration of the bed (gradient and roughness). Describes model channel and mode of operation and use of photoelectric cell to measure density of distribution of soil in water, and electrically heated wire to measure velocity by measuring the wire's resistance over a wheatstone bridge. Correlation of experimental results with theory is hindered by the fact that a mixture of soil and water shows anomalous viscosity. Notes experiments with polydisperse material forming bed to show variation in average particle size at different stream depths.
5. A photo-electric apparatus for delineating the size frequency curve of clays or dust. Jour. Sci. Instruments, vol. 13, no. 7, pp. 229-233, illus., July 1936.
Describes an apparatus for delineating the size-frequency curve of clays or dusts by means of a beam of light and a photoelectric cell.
6. The suspension of solids in a turbulent stream. Roy. Soc. London, Proc., Ser. A, Math. and Phys. Sci., vol. 162, pp. 583-597, illus., Oct. 15, 1937.
Deals with model studies on the concentration of suspended material near the uniformly graded bed of an artificial channel and the ap-

plication of results to conditions in a natural stream. Discusses the theoretical aspects of the problem, and describes the experiments on the measurements of concentrations, and deals at some length with the application of the theory and results of the model studies.

7. Fundamental aspects of erosion. Nature, vol. 142, no. 3588, pp. 236-238, illus., Aug. 6, 1938.
Cites theories of silt movement and application of these theoretical considerations to erosion prevention. Note is made of experimental work by Gilbert, Hjulström and Richardson, both in model tests and actual river observations. Tests are noted on River Tyne, England at Newcastle, and the River Fyris at Uppsala in Sweden, as are the use of check dams on the River Alp in Switzerland. Describes model studies and use of photoelectric cell to measure silt load. Permeability of soil, grain size, viscosity, velocity gradient and shear forces as factors affecting silt transportation are noted.

RICHARDSON, F. H.

1. Varying silt load in the Colorado River [letter to editor]. Civ. Engin., vol. 3, no. 6, p. 333, June 1933.
Comments on Professor Chapman's article (Chapman, H. H., 3) on overgrazing as a factor in erosion. Cites report of Francisco de Ulloa that the Colorado River in 1536 was thick, black and very muddy. No evidence suggests that silt load of the Colorado River is greater now than in the sixteenth century.

RICHARDSON, HENRY B. See Ockerson, J. A., 1.
RICHART, F. E.

1. Engineering research. Engin. News-Rec., vol. 112, pp. 206-207, Feb. 8, 1934.
A progress report on engineering research conducted during 1933 in many different fields, particularly noting research of interest to hydraulic engineers conducted by the Mississippi River Commission at its Waterways Experiment Station near Vicksburg. Model tests made on problems of stream regulation, bank protection, floodway design, erosion at high velocities and deposition of sediment. Models of Bonnet Carre, Boeul and New Madrid spillways are noted.

RICHMOND, VA. WATER WORKS.

1. Laboratory report for the year ending December 31, 1905. Richmond, Va., Water Works, Ann. Rpt. 1905, pp. 13-37.
Presents an outline of the main results of examinations of James River waters, 1905, and of a series of experiments conducted to determine the best method of operating the settling and coagulating basins now under construction. Data are given on daily turbidity of the James River water for the year, the turbidity coefficient, or the degree of fineness of suspended matter in the James River water.

RICHTOFEN, FERDINAND VON.

1. Führer für Forschungsreisende (Guide for explorers). Rev. ed. 719 pp., illus. Hanover, Janecke Bros., 1901.
A guide for explorers which treats of various problems encountered in explorations. Investigates the mechanical work of rivers. Notes influences of erosion which are based on the stratification and condition of rock stratum. Treats of the deposition of sediment by running water in streams, lakes, and estuaries. Considers delta formation.

RIDDELL, J. L.

1. Deposits of the Mississippi and changes at its mouth. Com. Rev. South and West De Bow's Rev., vol. 2, no. 6, pp. 433-438, 1846.
Presents the results of an investigation made from May 21 to Aug. 13, 1846, to determine the amount of sediment carried into the sea by the Mississippi River. Contains an analysis of the chemical composition of 100 grains of Mississippi sediment. Considers also deposition of sediment in the Mississippi Delta and the length of time required for the formation of the delta.

RIDENOUR, G. M.

1. Storage lake aids stream purification. Engin. News-Rec., vol. 123, no. 11, pp. 91-93, illus., Sept. 14, 1939.
Discusses observations on the usefulness of an

impounding reservoir, at Greystone Park, N. J., as a means of purifying the effluent from a sewage disposal plant; effects of storage and treatment of effluent on biochemical oxygen demand and on bacterial population; and quantity and distribution of sludge accumulations in the pond. The total amount of sediment deposited in the pond during a period of 8 yr. amounted to 65,000 cu. ft. of which 17 percent was sewage solids and the balance silt brought in by the river. Describes the nature of the sediment with respect to vertical distribution in the pond.

RIDGEWAY, ROBERT. See Sibert, W. J., 1.

RIES, H. See Gustafson, A. F., 2.

RILEY, N. ALLEN.

1. Projection of sphericity. *Jour. Sedimentary Petrology*, vol. 11, no. 2, pp. 94-97, illus., Aug. 1941.

Attempts to show the relationship between the various two-dimensional shape measures. Introduces a rapid method adaptable to sand-size particles.

RINDLAUB, BRUCE D. See Kramer, H., 2; O'Brien, M. P., 2.

RINGLAND, A. C.

1. Sybaris: An example of watershed control in operation. *Soil Conserv.*, vol. 3, no. 1, pp. 11-13, 28, illus., July 1937.

Discusses the need for and describes the Sybaris project in Calabria, Italy. Includes four paragraphs discussing conditions of stream-bank sliding and the transportation and deposition of solid matter in the mountain streams of southern Italy noting in particular these conditions along the River Crati. Notes that the problem of controlling waters of the Sybaris plains by construction of embankments and diversions is difficult because of the enormous quantities of solid matter carried down to the plains by the mountain streams and the River Crati.

RIPLEY, HENRY CLAY. See also Fawcett, P. N., 1.

1. The economic location of jetties. *Amer. Soc. Civ. Engin., Trans.*, vol. 87, pp. 979-986, illus., 1924.

Deals with the proper location of jetties on ocean bars for the purpose of maintaining navigable channels. Describes design and effectiveness of various types of jetties. Conditions necessary for the successful operation of jetties are given, and cases cited.

Discussion: JOHN R. FREEMAN, pp. 1103-1104, notes need for laboratory work on river and harbor hydraulics. W. M. BLACK, pp. 1104-1106, points out in connection with the design and location of jetties, the factors affecting conditions of the transportation and deposition of material at channel entrances. LEWIS MUHLENBERG HAUPT, pp. 1106-1118, notes the utility and economy of single off-shore barriers when properly built. Discusses various types of jetty construction in Europe, Asia, and North and South America. Presents data on a single curved jetty at Aransas Pass, Tex., which has maintained a good navigable channel by the control of littoral drift and the utilization of a feeble tide. CHARLES E. L. B. DAVIS, pp. 1118-1119, criticizes the use of the curved form of jettied channel. THE AUTHOR, pp. 1119-1129, weighs deductive and inductive methods of approaching the question of bar deepening, observing that plans obtained by the deductive method proved unsuccessful; plan obtained by the inductive method for the improvement of the entrance at Aransas Pass, Tex., developed and maintained the prescribed channel unaided by dredging or other artificial help, as was predicted. Comments on discussions by Black, Haupt, and Davis in connection with the formation of bars at mouths of sediment-bearing streams and the effect of a curved jetty concave toward the current, the design and location of jetties to produce and maintain permanent navigable channels, and conditions of curvature of a proposed jetty.

RITCHIE, T. MORTON. See Mill, H. R., 1.

RITTENHOUSE, GORDON. See also Broughton, W. A., 1; Brown, C. B., 9; Happ, S. C., 2, 3, 5, 6; Mac-Clintock, P., 1; Swenson, F. A., 1.

1. A suggested modification of the pipette method. *Jour. Sedimentary Petrology*, vol. 3, no. 1, pp. 44-45, illus., Apr. 1933.

Suggests a modification of the pipette method. This technique eliminates the necessity for a shaking or stirring device and would simplify any mechanization of the pipette method.

2. Recent erosion investigations and their geologic significance [abstract]. *Geol. Soc. Amer., Proc.*, p. 108, June 1938.

Presents a compilation of data on rates of erosion and continental denudation based on determinations of the amount of erosion from small areas under various conditions of soil, slope, and cover; amount and rate of reservoir silting; and the extent of valley aggradation during known periods of time. Factors to be considered in estimating rates of land surface reduction are briefly discussed.

3. Criteria used in recognizing modern fluvial sediment [abstract]. *Wash. Acad. Sci., Jour.*, vol. 28, p. 414, Sept. 1938.

Defines modern sediments as those fluvial deposits formed by accelerated sedimentation resulting from agricultural use of uplands and briefly notes the methods used to recognize and determine the thickness and lateral extent of such deposits.

4. The pipette method modified for mass production. *Natl. Res. Council, Div. Geol. and Geog. Com. on Sedimentation, Rpt. 1938-39*, pp. 88-102, Sept. 1939.

Describes a modified pipette method for mass mechanical analyses of fine-grained sediments. Modifications in method and improvements in technique reduce materially time per analysis. Lists the necessary equipment.

5. A method of comparing heavy minerals in sedimentary deposits [abstract]. *Geol. Soc. Amer. Bul.*, vol. 50, no. 12, pt. 2, pp. 1930-1931, Dec. 1, 1939.

Briefly notes the writer's method of comparing heavy minerals in sedimentary deposits.

6. Curves for determining probable errors in heavy mineral studies. *Natl. Res. Council, Div. Geol. and Geog. Com. on Sedimentation, Rpt. 1939-40*, pp. 97-101, illus., Dec. 1940.

Presents curves from which the probable errors in heavy mineral studies could be determined. The probable errors are expressed as percent of heavy minerals frequency and as percent of total number of all heavy mineral grains.

7. (and Bertholf, W. E., Jr.). Gravity versus centrifuge separation of heavy minerals from sand. *Jour. Sedimentary Petrology*, vol. 12, no. 2, pp. 85-89, Aug. 1942.

Tests the relative efficiency of gravity and centrifuge separation of heavy minerals in sand. Notes that the percentages of heavies by weight differ significantly and number frequencies do not, that gravity separation tends to effect a cleaner separation of high than low specific gravity minerals, and states that centrifuge separation is equally effective for all minerals.

8. Conversion charts for sediment concentration by weight in suspended-load samples and for sediment concentration to volume of deposits. *U. S. Soil Conserv. Serv., Sedimentation Div. Tech. Let.*, Sed-17, 2 pp., illus., Nov. 18, 1942.

Treats the use of a conversion chart for converting sediment concentrations by weight in suspended-load samples and for sediment concentration to volume of deposits.

9. Transportation and deposition of heavy minerals. *Geol. Soc. Amer. Bul.*, vol. 54, no. 12, pp. 1725-1780, illus., Dec. 1, 1943; [abstract], *Geol. Soc. Amer. Bul.*, vol. 53, no. 12, pt. 2, p. 1807, Dec. 1, 1942.

Points out that an attempt to use heavy minerals to evaluate sediment sources in the Middle Rio Grande Valley illustrated the inadequacy of commonly used methods of representing heavy-mineral compositions. Studies 6 samples from a transverse channel section by quantitative methods in order to develop a usable method. Size distribution curves by weight of 12 heavy minerals were similar to those of light minerals, being displaced toward finer sizes. The composition of heavy minerals varied systematically with differences in average size and sorting of the light minerals.

- Notes various factors upon which the size distribution of a heavy mineral in a fluvial deposit appears to depend. Recommends the hydraulic ratio as a genetically sound method of representing the heavy-mineral composition of sediments. Notes changes in the hydraulic ratio caused by wear, selective transportation, and other factors. Discusses other methods of representing heavy mineral compositions and outlines their limitations.
10. Measuring intercept sphericity of sand grains. Amer. Jour. Sci., vol. 241, no. 2, pp. 109-116, illus., Feb. 1943.
Describes a measuring wedge by which three mutually perpendicular diameters of sand grains may be measured to determine intercept sphericity, the breadth/length ratio, and flatness ratio.
 11. Relation of shape to the passage of grains through sieves. Indus. and Engin. Chem., vol. 15, no. 2, pp. 153-155, illus., Feb. 15, 1943.
Presents quantitative data on two factors which cause the passage of oversize grains through sieves: (1) the relative importance of the few oversized holes in the sieve; (2) the passage of flattened grains through the sieve opening diagonally. Outlines several types of investigations in which shape-calibrated sieves can be used advantageously.
 12. Field determination of suspended load by hydrometer. U. S. Soil Conserv. Serv., Sedimentation Div., Tech. Let., Sed-18, 4 pp., July 16, 1943.
Describes the hydrometer method for field determinations of suspended load. Method will yield usable results when the method of sampling or natural variations in the concentration of suspended load in streams make the determination of instantaneous load accurate only to several hundred parts per million.
 13. A visual method of estimating two-dimensional sphericity. Jour. Sedimentary Petrology, vol. 13, no. 2, pp. 79-81, illus., Aug. 1943.
Determines rapidly by visual comparison with a chart the two-dimensional sphericity of sands and other fine-grained particulate materials; mean sphericities so obtained are sufficiently accurate for many types of investigations.
 14. (and Thorp, E. M.). Heavy minerals in sediment-transportation studies. Amer. Geophys. Union, Trans., vol. 24, pt. 2, pp. 524-530, illus., 1944.
Points out that in natural fluvial deposits, the size distributions of heavy minerals are known to vary systematically with the size-distribution of the lighter minerals with which they occur. Outlines the analytical technique that can be used in investigations in determining the extent to which specific gravity, shape, and hydraulic factors govern these systematic variations. Presents the results obtained from a study of three samples from a vertical section collected near Escondido, N. Mex. Notes that these samples demonstrate that heavy minerals can be used to test equations that describe the vertical distribution of suspended load and related purposes, if the requisite hydraulic data are available.
 15. (and Connaughton, M. P.). Errors in sampling sands for mechanical composition. Jour. Sedimentary Petrology, vol. 14, no. 1, pp. 20-25, illus., Apr. 1944.
Presents the errors involved in determining the median grain size, the Trask sorting coefficient, and the percentages of sediment in individual size grades for fluvial sands and heavy minerals in such sands. Discusses the relation between sampling errors for heavy minerals and for entire samples.
 16. Sources of modern sands in the Middle Rio Grande Valley. Jour. Geol., vol. 52, no. 3, pp. 145-183, May 1944.
Determines the relative importance of various sediment sources in causing sediment damage by the use of the heavy-mineral composition of channel deposits of the Rio Grande and its tributaries. Shows that about 48-54 percent of the Rio Grande channel and floodway sand deposits between San Acacia and San Marcial have come from the Rio Puerco, 19-21 percent from the Rio Salado, and 25-33 percent from the rest of the drainage basin; of the channel and floodway deposits between Albuquerque and Bernardo, about 21-39 percent have come from the Rio Grande above Cochiti, N. Mex., and the rest from small tributaries. Notes that since 1880 there have been marked changes in the contribution from some tributaries and in mineral composition of Rio Grande sands between San Acacia and San Marcial; tributary contributions to the main stream did not change greatly during the 5-yr. period, 1937-41. Bases all source evaluations on the hydraulic ratios of the heavy minerals; outlines reasons why other methods of representing mineral compositions are not suitable.
- RIZER, RALPH L.
1. 1936 flood, rehabilitation and control work in Maryland. Baltimore Engin., vol. 12, no. 2, pp. 7-10, Aug. 1937.
Describes causes and effects of the flood of 1936 in western Maryland, and outlines the proposed flood control works. Notes that flood waters left mud and silt varying in depth from 8 to 15 in. in Cumberland, Md.
- ROACH, LEE S. See Wickliff, E. L., 1.
- ROBBINS, A. G.
1. On the control of rivers and the prevention of floods. Technol. Quart., vol. 1, no. 1, pp. 1-16, illus., Sept. 1887.
Discusses the effect of the construction of levees, cut-offs, tributary deviation works, and artificial outlets upon the regimen of sediment-bearing streams.
- ROBERTS, B. S.
1. Reclaiming the waste lands of the lower Mississippi. Franklin Inst. Jour., vol. 84, no. 6, pp. 385-392, Jan. 1867.
This letter, addressed to E. M. Stanton, Secretary of War, outlines a plan for the reclamation of waste lands of the lower Mississippi Valley. The suggestion is to dike the river, and with a system of waste weirs and gates constructed in the river levees, to divert sediment-laden flood waters of the stream so as to overflow extensive areas of unredeemed land in the lower Mississippi Basin. Deposition of sediment on these lands would create rich, fertile delta land. Describes the general regime of the Mississippi River and its tributaries noting in particular conditions conducive to the transportation and deposition of sediment. Discusses the economic aspects of the plan and details of construction of the proposed works.
- ROBERTS, E. J. See Dorr, J. V. N., 1.
- ROBERTS, MILNOR W.
1. The improvement of the mouth of the Mississippi. Amer. Soc. Civ. Engin., Trans., vol. 4, pp. 321-333, Oct. 1875.
Discusses improvements at the mouth of the Mississippi River. Includes a discussion on the formation of a delta at the mouth and the formation and movement of bars at outlets of main channels. The purpose of the jetty system is to maintain the velocity of the river upon reaching the mouth resulting in sedimentation at a considerable distance seaward; also, to cut away the bed of mud and sand and carry the sediment to the sea. Notes inability of the jetties to arrest the power of the river when its design is accomplished and suggests the use of dikes or walls to give sufficient velocity to prevent deposition of suspended matter and prevent scour of river bottom.
2. On improvement of the mouth of the Mississippi River. Amer. Soc. Civ. Engin., Trans., vol. 5, pp. 275-281, illus., 1876.
Discusses the improvement of passes at the mouth of the Mississippi River, including bar formation at mouths of passes and problems encountered in dredging the channel. The effect of jetty construction is given.
- ROBERTS, T. P. See also Chittenden, H. M., 1.
1. Floods and means of their prevention in our western rivers. Engin. Soc. West. Pa., Proc., vol. 23, no. 6, pp. 306-324, illus., July 1907.
Describes methods for the prevention of floods in western streams. Includes a brief discussion of the effect of levees upon the silting up of

stream beds and the effects of artificial and natural obstructions in streams upon flood heights.

2. The Monongahela River. Engin. Soc. West. Pa., Proc., vol. 24, no. 4, pp. 193-220, illus., May 1908.

Describes the various characteristics of the Monongahela River. Includes a brief description of character of bed and banks, condition of bank erosion, the effect of industrial wastes upon the quality of the river water, and the effect of reduction of current velocities caused by fixed dams upon conditions of silt deposition in the stream.

ROBERTS, W. J.

1. (and Thompson, R. H., and Ramsay, C. C.). Report on flood control of White-Stuck and Puyallup Rivers, King and Pierce Counties, Washington. 75 pp., illus. Olympia, Wash. State Engin., 1920.

Describes details of existing and proposed improvements made on the White-Stuck and Puyallup Rivers, Pierce and King Counties, Wash. W. J. Roberts describes details of works to increase channel capacities to carry floods, drift barrier and dam construction, river clearing, and bank protection. R. H. Thompson reviews the history of improvements since 1906, summarizes previous reports noting in particular the problem of sedimentation involved in proposed river improvement; describes the value, effectiveness of the drift barrier and Auburn dam; notes need for extended river clearing; describes proposed measures for flood and debris control in the Stuck River County Line section, and discusses other suggested flood relief improvements.

ROBERTSON, J. M. See Kalinske, A. A., 6; Van Driest, E. R., 2.

ROBERTSON, L. E.

1. Economic method of desilting canals devised for Imperial Valley districts. Hydraulic Engin., vol. 1, pp. 20, 44-45, illus., Jan. 1929.

Describes the use of portable power units that drive high pressure centrifugal pumps to desilt canals and drainage ditches in the Imperial Irrigation districts. Characteristics of suspended silt entering canals of the lower Colorado River basin are briefly described.

ROBERTSON, ROBERT R.

1. Problems of the Sacramento River. Military Engin., vol. 34, pp. 392-396, illus., Aug. 1942.

Discusses problems of the Sacramento River including hydraulic mining debris control, flood control, mining problems, maintenance of navigable channels, invasion of saline water, irrigation, and power.

ROBESON, F. A. See Willis, E. A., 1.

ROBINSON, A. G. See Federated Malay States and the Straits Settlements. Drainage and Irrigation Dept., 1.

ROBINSON, A. W. See Heindenstam, A. V. H. von, 1; Ockerson, J. A., 4.

ROBINSON, GILBERT WOODING.

1. A new method for the mechanical analysis of soils and other dispersions. Jour. Agr. Sci. [London], vol. 12, pt. 3, pp. 306-321, July 1922.

Discusses the expression of mechanical composition by means of continuous curves. Examines the effect of gel coating on the settling velocity of a particle. Outlines a method for determining the mechanical composition of a soil or clay from determinations of the concentration of a settling suspension for different values of depth/time. Describes a shortened method of mechanical analysis and examines the nature of concentration gradients in a settling column of suspension.

2. The form of mechanical composition curves of soils, clays, and other granular substances. Jour. Agr. Sci., vol. 14, pt. 4, pp. 626-633, Oct. 1924.

Considers the form of mechanical composition curves which reveal certain regularities. Notes that the most common type of curve is a sigmoid.

3. The dispersion of soils in mechanical analysis. Imp. Bur. Soil Sci. Tech. Commun. 26, 31 pp., tables, 1933.

Deals with experiments on a comparative study of various methods of dispersion of soils in

mechanical analysis. Points out that the International method with modifications gives satisfactory dispersion. An examination was made of 120 representative samples of soils.

ROBINSON, H. F. See also Bryan, K., 10; Taylor, T. U., 6.

1. The silt problem of the Zuni Reservoir. Amer. Soc. Civ. Engin., Trans., vol. 83, pp. 668-678, illus., 1920; also in Amer. Soc. Civ. Engin., Proc., vol. 45, no. 6, pp. 483-493, Aug. 1919; [abstract], Engin. and Contract., vol. 52, pp. 294-296, illus., Sept. 10, 1919; Engin. News-Rec., vol. 84, no. 3, p. 145, Jan. 15, 1920.

Deals with the silting of reservoirs in the arid region of the United States with special reference to Zuni Reservoir in New Mexico, which lost 60.7 percent of its capacity in 12 1/2 yr. Gives description of dam and notes that observations for the period of 12 1/2 yr. shows a total silt deposit of 5,507 acre-feet, and an average silt content of 1.88 percent. Notes that reservoir will be silted to within 1 ft. of spillway level by June 1926; if dam is raised 10 ft., estimated date of complete filling with silt is 1939. Notes loss in capacity due to silting of Lake McMillan, N. Mex. of 50 percent in 15 yr.; to Austin Reservoir, Tex., loss of 38 percent in 4 yr. and 48 percent in 7 yr. Includes general discussion of silt content of Rio Grande, Zuni, and Kaw Rivers, Bonita Creek, Moencopi, Wash. Records at Zuni show little relationship between magnitude of flow and silt carried. Discusses problems of silt removal and prevention.

Discussion: ELWOOD MEAD, pp. 879-881, notes that Zuni Reservoir lost six-tenths of its capacity in 12 1/2 yr. and reservoir near Carlsbad, N. Mex., lost more than half its capacity in 15 yr. Discusses problem of water conservation noting need for desilting processes to increase life of reservoirs. Notes that in northern half of arid Southwest, silting process is slow and cost of removing sediment would not be prohibitive. Describes provision for lengthening life of Elephant Butte Reservoir planned and executed by L. C. Hill (former engineer of U. S. Reclamation Service) by increasing height of dam in successive stages to prolong useful service of reservoir for 300 yr. Roosevelt Dam has similar provisions for increased height but erosion on its watershed may be controlled by preservation of forests and vegetable growth in order to prolong its life. CLARENCE S. JARVIS, pp. 881-885, gives apparent and actual capacities of reservoirs noting that safest and best reservoir sites are in the voids of sedimentary deposits. Describes methods of removing sediment from reservoirs by means of hydraulic giants noting that alluvial silt thus removed and distributed upon irrigated lands has immense value as fertilizer and prevents percolation losses in canals. Discusses proposed method of silt removal from Elephant Butte Reservoir. Notes that preferable way to prevent excessive sedimentation is to reduce erosion on watershed. Discusses effectiveness of direct sluicing by natural stream to clean reservoirs and notes need for maintaining continual clearance of reservoir silt. GEORGE M. POST, pp. 885-888, notes that during construction of Zuni Dam, J. B. Harper estimated that the probable life of the reservoir would be 35 yr. Robinson notes that silt inflow is even more rapid than that predicted by Harper. Discusses necessity of prevention of reservoir silting by control in watershed. Describes conditions in watershed which are conducive to reservoir silting. Outlines means of gully control by check dams, which would aid in checking silting of reservoirs. Notes that in 1919 deposited silt in reservoir amounted to 1,250 acre-feet, and that at this annual rate, the reservoir would fill in 7 yr. THE AUTHOR, pp. 888-893, gives additional data on silting of Zuni Reservoir, noting that 1,248 acre-feet of silt had been deposited in reservoir in 1919, while average annual deposit for 13 1/2 yr., through 1918, was 557 acre-feet; average silt

ROBINSON, H. F. - Continued

content during 1919 was 2.66 percent. Discusses the relationship between runoff and percentage of silt carried by water. Comments on previous discussions of paper with reference to actual and apparent capacities of reservoirs, removal of silt, and prevention of excessive sedimentation by erosion control. Notes practicability of raising Zuni Reservoir 10 ft. thereby increasing its life span 50 percent.

ROBINSON, T. W. See Stearns, H. T., 1.

ROBINSON, W. G.

1. "Undisclosed assets"—Disposing of silt. *Dakota Farmer*, vol. 54, pp. 260-261, illus., June 9, 1934. Describes methods proposed by the Upper Missouri Valley Development Association for the improvement of the Missouri River for navigation and flood control. The effects of conditions of silt transportation and deposition in the river are considered.

ROCHE, R. See Pellet, H., 1.

ROCKIE, W. A.

1. Serious erosion caused by heavy rain of July 30, 1931, near Colfax, Washington. *Monthly Weather Rev.*, vol. 60, pp. 22-23, illus., Jan. 1932. Describes effects of the storm of July 30, 1931 near Colfax, Wash., conditions of erosion and deposition, effect of vegetal cover on silt deposition, and movement of soil "bowliders."
2. (and McGrew, P. C.). Erosive effects of heavy summer rains in southeastern Washington. *Wash. Agr. Expt. Sta.*, Bul. 271, 8 pp., illus., July 1932. Describes the erosive effects of the heavy rain of July 30, 1930, over an area of about 50 sq. miles south-southwest of Colfax, Wash. Storm was typical of those afflicting the "Palouse" country of the Pacific Northwest.

RODMAN, G. A. See Fristoe, R. E., 1.

RODWELL, J. A.

1. Pre-storage problems. *Water and Water Engin.*, vol. 38, no. 465, pp. 377-384, illus., Midsummer 1936. Deals with the control of catchment areas which drain directly into water supply reservoirs. Considers the problem of reduction of reservoir capacity due to silt and debris deposition, and means whereby silt and other material carried by streams can be arrested and removed. Briefly discusses results of observations on the effect of afforestation on the quantity of suspended matter carried by streams.

ROEFOSSEN, P. A.

1. Government hydro-electric plant in the Tjatoer Valley near Madioen, Java. *Elect. Jour.*, vol. 19, no. 4, pp. 160-162, illus., Apr. 1922. Describes details of design of the government-operated hydroelectric plant in the Tjatoer Valley near Madioen, Java, and details of a sedimentation reservoir used to keep sand and gravel from entering the penstocks and turbines of the plant.

ROGERS, H. S.

1. (and Mockmore, C. A., and Adams, C. D.). A sanitary survey of the Willamette Valley. *Oreg. Engin. Expt. Sta. Bul.* 2, 55 pp., illus., June 1930. Presents results of observations on bacteria, oxygen, suspended and dissolved solids, and nitrate determinations of waters of the Willamette River and its tributaries, during July-August 1929.

ROGERS, JOHN.

1. [Review of] *Sedimentary rocks*, by F. J. Pettijohn. *Amer. Jour. Sci.*, vol. 247, no. 9, pp. 667-668, Sept. 1949. Presents various comments on the book (Pettijohn, F. J., 5) which deals with the properties of sedimentary rocks, kinds of sedimentary rocks, and processes that form sedimentary rocks. Points out that the material shows signs of hasty compilation and contains contradictory data. The report has much good material and it is hoped that Prof. Pettijohn will revise the book so as to make it a safe and adequate guide for students.

ROHWER, CARL. See Fortier, S., 2.

ROLLER, PAUL S. See also Traxler, R. N., 1.

1. Separation and size distribution of microscopic particles—an air analyzer for fine powders. *U. S. Bur. Mines, Tech. Paper* 490, 46 pp., illus., 1931.

Describes an air analyzer for determining size and size distribution of microscopic particles. The principle used is of air separation and is based on Stokes' law. Describes briefly various methods of particle-size analysis of microscopic powder and considers the general graphical methods with reference to the frequency distribution of the diameters of particles.

2. A classification of methods of mechanical analysis of particulate materials. *Amer. Soc. Testing Mater., Proc.*, vol. 37, pt. 2, pp. 675-683, 1937. Presents a classification of methods of size analysis depending on the underlying principles involved. Places the methods of analysis into five classes and the methods of these classes are discussed. Considerations in selecting a method of size analysis are commented on.

3. Law of size distribution and statistical description of particulate materials. *Franklin Inst. Jour.*, vol. 223, no. 5, pp. 609-633, illus., tables and graphs, May 1937.

Discusses a law of size distribution which relates the weight percent, and from this derives the frequency, to the size of particle for finely divided materials. Gives advantages of applying the distribution law to experimental observations and treats the solution for physical constants by means of the distribution law.

ROMINGER, J. F. See Dapples, E. C., 1.

ROOD, E. C.

1. Surface water inlets into ditches. *Iowa State Drain. Assoc. Proc.*, 6, vol. 12, pp. 37-41, 1910. Describes conditions of wash-ins in drainage ditches of Iowa. Suggests use of surface water inlets to prevent damage to open ditches.

ROOK, JOHN.

1. On deepening, cleaning, excavating, and removing obstructions that prevent vessels from entering harbors [letter to editor]. *Ann. Phil.*, vol. 5, pp. 206-207, illus., Jan./June 1815. Describes a method of removing considerable quantities of sand, gravel, etc., from harbors at the mouths of rivers.

ROOKE, W.

1. New method of trapping and spreading silt; application to South African conditions of Burmese river-training system. *Farmers Weekly [Bloemfontein]*, vol. 71, pp. 2461, 2463, illus., Sept. 4, 1946. Describes a new method of trapping and spreading silt devised in Burma. Comments on the application of such a method to river-training problems in South Africa.

ROSE, C. W.

1. Observations on a flotation type of erosion in the Chenango Valley. *Soil Conserv.*, vol. 5, no. 12, pp. 299-300, illus., June 1940. Describes the occurrence and conditions of the flotation type of erosion in the Chenango River flood plains, Chenango County, N. Y. Porous water-soaked surface soils, frozen into cohesive masses, are buoyed up during spring freshets and floated downstream. Downstream flood-plain deposits of blocks of soil evidence this type of erosion.
2. Flotation erosion by ice. *Jour. Geomorph.*, vol. 4, no. 2, pp. 142-144, illus., Apr. 1941. Describes the occurrence and conditions of the flotation type of erosion in the low-lying areas of the Chenango River flood plain, Chenango County, N. Y. Water-soaked surface soils, frozen into coherent masses, are buoyed up during spring freshets and floated downstream. Downstream flood-plain deposits of blocks of soil evidence this type of erosion.

ROSE, LONNIE E. See Harper, H. J., 6.

ROSE, N. K.

1. Regime channels in alluvium [abstract]. *India Cent. Bd. Irrig. Pub.* 29, pp. 81-82, 1943. Presents a set of three formulas from which a channel may be designed for "normal" silt charge.

ROSS, CLARENCE S.

1. (and Kerr, Paul F.). The clay minerals and their identity. *Jour. Sedimentary Petrology*, vol. 1, no. 1, pp. 55-65, illus., May 1931. Discusses the minerals which characterize the clays. Divides the clay minerals into four groups, the kaolin group, the montmorillonite-

bedellite group, the potash-bearing clays, and a group whose properties have not been definitely determined and are found in many shales. Notes origin of clay minerals and bases in clays.

ROSS, CLYDE P.

1. The lower Gila region, Arizona. U. S. Geol. Survey, Water-Supply Paper 498, 237 pp., illus., 1923. Deals chiefly with various aspects of irrigation in the lower Gila region. Includes brief description of early changes in the channel of the Gila River and present conditions of deposition.

ROSSITER, EDGAR A.

1. Recommended flood control measures for the Mississippi Valley. Munic. and County Engin., vol. 72, no. 5, p. 205, May 1927. Recommends measures to keep the lower Mississippi free of debris and silt in order to ameliorate flood conditions. States that the continuous raising of existing levees is futile.

ROTH, E. H. See Fristoe, R. E., 1.

ROTH, W. J.

1. (and Garin, A. N.). Economic implications of a soil and water conservation program. Soil Conserv., vol. 3, no. 8, pp. 223-225, Feb. 1938.

Comments on the economic implication of a soil and water conservation program. Includes five paragraphs relative to the economic aspects of reservoir silting, noting investigations in 1934 by the Section of Sedimentation Studies of the silting rate of the Greensboro and High Point Reservoirs and giving estimates of the rate of filling of Burlington and Winston-Salem reservoirs. Calculations indicate a 36 percent loss of original capacity of the four reservoirs following a 40-yr. period of average silt accumulation. Although precise calculations relative to soil-erosion control value are not available, silt sampling carried on in 45 percent of the Deep River area of High Point since 1934 indicate a 25 percent diminution in the quantity of silt in stream runoff. Notes that the U. S. Soil Conservation Service plans a comprehensive cost study of erosion-control measures for dissemination of information to concerned communities.

ROTHERY, SYDNEY LIONEL. See also Buckley, A. B., 1.

1. A river diversion on the Delta of the Colorado in relation to Imperial Valley, California. Amer. Soc. Civ. Engin., Trans., vol. 86, pp. 1412-1438, illus., 1923.

Deals with a diversion of a river on the Colorado Delta and its relation to Imperial Valley, Calif. Describes the formation of Imperial Valley by the deposition of a deltaic ridge by the Colorado. Continued broadening and elevation of the ridge necessitates a large annual expense for levees. Notes the feasibility of, and results to accrue from, the proposed diversion. Gives reasons for the selection of the diversion site and river characteristics affecting diversion. Discusses the capacity of the river to transport and deposit sediment and the requirements for soil erosion. Cites conclusions on which commencement of the work was based; outlines progress from January 1921 to complete diversion by Feb. 27, 1922. Describes the later failure of the dam, its repair, and the necessity for extensive use of heavy rock facing. Notes three principal features of changing conditions at the diversion inlet January-June 1922. Estimates the useful life of the diversion project at 15 yr. Notes the elevation of terrain from under 1 ft. to 13 ft. along the diverted route, as a result of sedimentation during 10 wk. of the 1922 flood. Discussion: PAUL M. ENTENMANN, pp. 1439-1445, commends the policy of making careful investigation before starting a river-control structure. Calls Mr. Rothery too optimistic in his conclusions on the feasibility of river diversion. Stresses the importance of the rock-fill dam in blocking the old river channel. Notes the high silt content of the Colorado, with a specific gravity of 2.65, tending to rapid deposition. Lists six attempts to divert the Colorado without using a dam to lock the old channel, discusses influences that caused five to fail, and describes the cut-off that succeeded. Attributes success to an accidental change in the direc-

tion of the channel above the inlet. Describes the final effect of a successful diversion at Olive Lake Cut-Off as calamitous. THE AUTHOR, pp. 1445-1447, observes the value of Mr. Entenmann's discussion from the viewpoint of its pertinency to the success of Olive Lake Cut-Off and as a warning against costly diversion projects without proper preliminary work. Cites the careful preparation for delta diversion as an example. Notes the occurrences of erosion as the quantity of water increased. Says deposition may elevate the ground below the outlet above the present treetops. Discusses the control of kinetic energy by the dam at the diversion inlet. Stresses the importance of the rock-fill dam and cites continued successful functioning of the Pescadero Diversion.

2. An irrigation project of the California. Inst. Civ. Engin., Minutes of Proc., vol. 216, pp. 161-182, illus., 1923; [abstract], Engineering, vol. 115, no. 2984, pp. 310-311, Mar. 9, 1923.

Discusses various works and problems concerned with an irrigation project just north of the Gulf of California controlled by the Imperial Irrigation District, a municipal corporation. Notes monthly volumes of silt in acre-feet in Colorado River discharge at Yuma. Notes the amounts of monthly silt in acre-feet diverted into the canal system 1912-21. Compares the capacity of the Colorado for silt transportation with the Ganges.

Discussion: ARTHUR BURTON BUCKLEY, pp. 214-215, comments on the high silt content of the Colorado River. F. V. ELSDEN, pp. 223-227, treats the similarity of conditions described by Mr. Rothery with those of irrigation works in the Punjab.

3. Silt and channel conditions in Colorado River Delta. Engin. News-Rec., vol. 95, no. 27, pp. 1068-1071, illus., Dec. 31, 1925.

Discusses silt conditions in the Colorado River, particularly as they affect the delta of the river. The transportation of silt at Yuma, 1915-24, is noted and illustrations are given to emphasize its extent. Changes of channel since 1908 (in 1909, 1918, and 1922) are noted particularly in Baja, Calif., Mexico and in the Pescadero country. Conditions in the latter diversion are noted in detail and the need for engineering control to prevent silting of diversion channels or levee breaks is stressed.

4. A problem of soil in transportation in the Colorado River. Amer. Soc. Civ. Engin., Trans., vol. 99, pp. 524-543, illus., 1934.

Deals with the exclusion of soil carried by the Colorado River from the Imperial Valley canal system in California. Summarizes data from paper by C. E. Grunsky relative to the transportation of silt in suspension and as bed load by the Sacramento and Colorado Rivers and by the Imperial Canal (Grunsky, C. E., 5). Examines the relative importance of Colorado River bed load and extent of volumes of material transported. Describes the vast amounts of material transported by recurrent scouring in the Colorado River, the characteristics of bed load and suspended load, the bed load movement, and the distribution of total load in stream cross-section. Outlines future river flow conditions relative to sediment transportation with consideration of factors affecting the sediment load of the stream, such as changes in stream channel below Hoover Dam after its completion. Desilting arrangements noted. Discusses the structural requirements for exclusion of bed load from the Imperial Valley canal system, stating that desilting basins can remove bed load and heavier silt particles but not to any appreciable degree the suspended load. The suspended load will diminish with stream stabilization to new gradients. Silty canal flow is desirable for land reclamation, but clear water demands for irrigation purposes necessitate a desilting structure as outlined in the paper. Suggested diversion structure would exclude bed load and part of the suspended load, probably eliminate necessity for desilting basins, lessen sluicing operations, and operate at reduced cost.

Discussion: C. E. GRUNSKY, p. 544, comments briefly on bed-load removal at headworks of proposed All-American Canal, the physical characteristics of Colorado River silt, the relative bed and suspended loads of the Colorado, and the silt problem at diversion points below Hoover Dam. IVAN E. HOUK, pp. 544-546, gives bed-load computations based on estimated average depth of periodic flood scour in lower Colorado River. Describes silt sampling methods, and factors affecting the sediment load of the Colorado below Hoover Reservoir. Notes effect of Elephant Butte Reservoir on soil transportation problem of the Rio Grande. H. M. ROUSE, pp. 547-549, points out the harmful effects of bed sand present in Imperial Valley irrigation system and advantages derived from the removal of bed sand at headworks of canals. Discusses the necessity for, and design of, desilting basins in addition to bed sand removal works. Examines need for model study of diversion works with desilting and bed-load removal devices pursuant to achieving greater efficiency in design. WILLIAM T. COLLINGS, JR., pp. 549-555, comments on Rothery's design of diversion structure at canal headworks as applicable to the All-American Canal to eliminate desilting basins and to exclude bed load and heavier material in suspension. Factors affecting the utility of Rothery's design are discussed relative to size of structure, variations in river flow, available sluicing heads, transportation and deposition of silt. Hydraulic elements of flow are given with respect to various canals of the Imperial District. R. F. WALTER, pp. 555-559, considers several features of the design and construction of diversion and desilting structure as described by Rothery and officially designated the Imperial Dam by the U. S. Bureau of Reclamation noting its similarity in operation features to Laguna Dam. Notes that various other plans are under consideration by the U. S. Bureau of Reclamation for the exclusion of bed and suspended loads from canals. Beneficial and detrimental effects of sediment-laden irrigation waters, value of total silt-load determinations relative to design of desilting works, studies on rates of settlement of various sizes of silt particles, laboratory studies on quantity of silt that will be carried to Imperial Dam under regulated flow conditions, and problem of disposal of sludge accumulations in desilting works are briefly outlined. HARRY F. BLANEY, pp. 560-561, notes that observations on the suspended silt load of the Colorado River showed that suspended silt load at Topock, Ariz., was considerably greater than that at Yuma, Ariz., and that 36 percent (34 percent estimated by Howard) of silt at Topock became bed silt before passing Yuma (Fortier and Blaney). Estimates by various authorities of volume of silt transported annually by the Colorado River are given for different periods and calculated on various dry weights of silt per cubic foot. Observations on effectiveness of desilting arrangements at Laguna Dam are briefly discussed noting that desilting process affects character of irrigated surface soil. CALVIN V. DAVIS, pp. 561-564, presents modification of Rothery's intake design which would exclude bed load and most of suspended load under varying flood conditions from canals in lower Colorado River. THADDEUS MERRIMAN, pp. 564-565, notes that Rothery confirms writer's previous conclusion that "bottom load carried per unit of time is equal to volume of material scoured out per unit of length" as evidenced by the stability of regimen of the Colorado River between Black Canyon and Yuma. Notes possible change in stream regimen with completion of Boulder Canyon Reservoir. J. C. ALLISON, pp. 565-569, notes economic effects of the silting problem in the Imperial Valley irrigation districts. Discusses the problem of disposal of sludge from desilting works returned to unregulated channel of the Colorado River between Boulder and Imperial

Dams, the problem of justifiable and beneficial removal of suspended silt from the Imperial irrigation system, and the selection of the Laguna Salada Basin in Mexico at the lower end of the Colorado River as a terminal reservoir to retain finally the silt and bed sand of the river. THE AUTHOR, pp. 569-575, comments on the physical characteristics of Colorado River silt with reference to the distribution of suspended silt in stream cross-section. The shapes of sand and silt particles and conditions of deposition behind Boulder Dam, the effect of Boulder Dam on distribution of silt in cross-section at Imperial Canal intake is noted. Describes plan including use of stilling basins to obtain maximum clarity of water in canals, yet permitting sufficient silt flow for reclamation of new lands. Justifies calculations on estimated total volume of bed load. Relative efficiencies of desanding and desilting works, and problem of sludge removal are discussed.

ROUSE, HUNTER. See also Chang, Y. L., 1; Griffith, W. M., 2; Kalinske, A. A., 2; Otto, G. H., 5; Rothery, S. L., 4.

1. Modern conceptions of the mechanics of fluid turbulence. Amer. Soc. Civ. Engin., Trans., vol. 102, pp. 463-505, illus., 1937.

Summarizes and interprets modern scientific methods of approach which have made progress possible in connection with the problem of resistance in turbulent flow; the subject of flow in circular pipes is used as means of illustration. Discussion: JOE W. JOHNSON, pp. 512-520, considers application of principles to the hydraulic problem of silt transportation in open channels. THEODOR VON KARMAN, pp. 522-523, reports the value of experimental and theoretical investigations on the mechanism of turbulent flow. Cites correctness of formulas used for fluid resistance in actual practice, but suggests advantages in use of rational formulas. Believes that use of turbulence theory will facilitate systematic solution of many complex problems, such as that of silt transportation. THE AUTHOR, pp. 523-543, clarifies certain aspects of the problem which the discussers questioned; gives additional information pertaining to the mechanics of fluid turbulence.

2. Nomogram for the settling velocity of spheres. Natl. Res. Council, Div. Geol. and Geog., Com. on Sedimentation Rpt., 1936-37, pp. 57-64, illus., Oct. 1937.

Presents a nomogram for the determination of settling velocities of spheres.

3. Fluid mechanics for hydraulic engineers. 422 pp., illus. New York, McGraw-Hill Book Co., Inc., 1938.

A volume on fluid mechanics suitable as a text for advanced hydraulic classes. Considers the fundamentals of hydromechanics, mechanics of fluid resistance, and mechanics of wave motion. Contains one chapter on the transportation of sediment which deals with bed-load movement, sediment suspension, and sediment characteristics. Gives various mathematical equations and briefly mentions certain methods of sediment analysis.

4. Experiments on the mechanics of sediment suspension. Internatl. Cong. Appl. Mech., Proc. (1938) 5, pp. 550-554, illus., 1939.

Describes experiments on the mechanics of sediment suspension. Discusses fluid turbulence as a medium of lateral transport, and gives a basic equation of suspension. Describes experimental apparatus and characteristics of sediment chosen for experiments. The experiments provide definite verification of the suspension theory with regard both to the exponential nature of the distribution function and to the role played by settling velocity of sediment. Discusses experiments on similarity between mixing characteristics of sediment and of fluid, and on the behavior of graded sediment under conditions similar to those of sorted material.

5. Laws of transportation of sediment by streams; suspended load. 7 pp. Washington, 1939.

Report for the International Geodetic and Geophysical Union round-table discussion on The Role of Hydraulic Laboratories in Geophysical

- Research, at the National Bureau of Standards, Sept. 13, 1939, relative to studies of laws of transportation of suspended load by flowing water. Discusses laboratory studies of suspended load and gives various equations.
6. Laws of transportation of sediment by streams: suspended load. 10 pp. Iowa City, Iowa Inst. Hydraulic Res., 1939.
Discusses the analytical method of attack on the laws of transportation of suspended load by flowing water based upon theories of fluid turbulence.
 7. An analysis of sediment transportation in the light of fluid turbulence. U. S. Soil Conserv. Serv., Tech. Pub. 25, 25 pp., illus., July 1939.
Discusses various proposed methods for the analysis of sediment transportation in the light of fluid turbulence. Emphasizes the need for experimental data to provide necessary constants for proved functional relationships and outlines the points which await experimental study along the lines of a definite program of research.
 8. Criteria for similarity in the transportation of sediment. Iowa Univ. Studies in Engin., Bul. 20, pp. 33-49, illus., Mar. 1940.
Describes various methods of approach to the formulating of more general principles of sediment similarity than now exist in hydraulic model studies involving the transportation of sediment.
 9. Suspension of sediment in upward flow. Iowa Univ. Studies in Engin., Bul. 26, pp. 14-22, illus., Dec. 1941.
Analyses of the phenomenon by which particles become so dispersed as to be in a state of suspension in an upward flow. Notes that the method used may not yield a means of predicting the quantitative effect of turbulence on sediment distribution. Concludes that the use of upward flow for segregating the various grades of sediment is of value.
- ROWALT, E. M.
1. Soil defense in the Piedmont. U. S. Dept. Agr. Farmers' Bul. 1767, 63 pp., illus., 1937.
Deals with the erosion of soil and measures of defense which have proved successful in controlling erosion in that part of the Piedmont country lying in the States of Virginia, the Carolinas, Georgia, and Alabama. Conditions of stream and valley sedimentation and of reservoir silting in the Piedmont are briefly considered. A description of soil conservation in the Piedmont, sources of silt, extent of deposition of erosional debris, flood damages, reservoir silting, etc., are given.
 2. Soil defense of range and farm lands in the Southwest. U. S. Dept. Agr., Misc. Pub. 338, 51 pp., illus., June 1939.
Discusses condition of soil erosion in the Southwest and describes erosion control measures employed by the U. S. Soil Conservation Service since 1934. Includes a discussion on silting of reservoirs noting that surveys in 1935 showed that Elephant Butte Reservoir, built in 1914, lost 13.8 percent of its original capacity, San Carlos Reservoir lost 3 percent in more than 6 yr. Roosevelt Reservoir lost 6.17 percent between 1910 and 1925, McMillan Reservoir lost 55.5 percent in 38 yr., and Zuni Reservoir lost 76 percent in 21 1/2 yr. as a result of silting. Discusses sources of silt and water in the Southwest and related conditions of silt delivery to the Rio Puerto, Rio Salado, Rio Grande, San Simon, San Pedro, Gila, Little Colorado, San Juan, and Colorado Rivers. Notes detrimental effects of channel silting, deposition of silt on flooded lands, and silting in irrigation canals and ditches. A rise in river bed of Rio Grande above Elephant Butte Reservoir resulted in severe flood damages and swamping of valley lands. Notes that Rio Puerto contributes about 40 percent of the silt entering Elephant Butte Reservoir. Conditions of bank erosion on the Gila River are described, noting the economic losses involved. Indicates the effect of floods on the movement of water, rocks, and mud in northern Utah. Describes means of controlling the silt in the Gila River by adjustments in range management on the watershed and by bank protection work.
- ROWE, R. ROBINSON. See Matthes, G. H., 5.
- ROWE, W. P. See Eaton, E. C., 1; Sonderegger, A. L., 2.
- RUBEY, WILLIAM W. See also Grover, N. C., 12; Shultis, S., 8; Vanoni, V. A., 1.
1. The Illinois River, a problem in channel equilibrium [abstract]. Wash. Acad. Sci. Jour., vol. 21, pp. 366-367, 1931.
Deals with conditions of stream stability in the Illinois River. Notes features peculiar to this stream. Briefly summarizes conditions of dynamic equilibrium based on graded slope, adjusted cross-section, quantity of load and mean diameter of sediment transported, and discharge.
 2. Lithologic studies of fine-grained Upper Cretaceous sedimentary rocks of the Black Hills region. U. S. Geol. Survey Prof. Paper 165-A, pp. 1-54, illus., 1931.
Describes lithologic studies of fine-grained Upper Cretaceous sedimentary rocks of the Black Hills region. Reviews methods of mechanical analysis, notes measurement of sizes and the presentation of data in usable form. Comments on the settling velocity of particles in water and considers the graphic solution of accumulation and concentration curves.
 3. A need for closer cooperation among students of stream-work. Amer. Geophys. Union, Trans., vol. 12, pp. 216-219, 1931.
Stresses the importance to geologists and hydraulic engineers of a knowledge of the laws of stream dynamics. Discusses briefly the uncertainty of extant knowledge relative to the origin of meanders and related problems. Notes the necessity for the exact measurements of natural streams and the need for laboratory model studies to advance the knowledge of stream dynamics.
 4. Alluvial islands—Their origin and effect upon stream regimen [abstract]. Wash. Acad. Sci. Jour., vol. 22, p. 458, 1932.
Treats the origin of alluvial islands in Mississippi, Missouri, and Illinois rivers and their effect upon stream regimen. Discusses islands formed by deposits from heavily-laden tributaries and their effects upon width and area of stream cross-section and discharge, and conditions of equilibrium insuring constant transporting power.
 5. Equilibrium-conditions in debris-laden streams. Amer. Geophys. Union Trans., vol. 14, pp. 497-505, illus., 1933.
Expresses quantitatively the effect of various factors influencing equilibrium conditions in debris-laden streams. Discusses the loss of potential energy of water and debris in flowing downhill and the method of measuring the vertical distance that a mass of water and debris falls in flowing downhill. Changes in total kinetic energy along course of stream due to additions of water and debris by tributaries, consumption of energy due to friction, energy consumed in supporting debris, and settling velocities of particles are dealt with. Presents a general energy equation of stream work, and tests and possible application of equations. Gives consideration to the factor, stream-bed mobility or critical transporting force in discussing stream energetics. Gives general theoretical equation indicating an inverse relation between slope and proportionate depth. The validity of the equation is briefly considered.
 6. Settling velocities of gravel, sand, and silt particles. Amer. Jour. Sci., vol. 25, no. 148, pp. 325-338, illus., Apr. 1933.
Discusses settling velocities of gravel, sand, and silt particles. States that uniform settling velocity depends upon resistance of settling medium. For small particles resistance depends chiefly on viscosity of fluid; for large particles resistance is controlled by impact. Gives analysis of Stokes' law of viscous resistance which is found to apply to small rounded quartz grains, and an impact formula applicable to coarse sand, pebbles, and boulders. Published data confirm the deduction that the impact of rising current required to support a pebble can be deduced theoretically, and suggest approximate equivalence of settling velocities.

ties to velocities required to transport pebbles along the bed of a stream. The author combines Stokes' law and the impact formula in a general equation for settling velocities of large and small grains. The general equation accords very closely with published data on quartz grains but not so closely with data on fragments of galena.

7. The size-distribution of heavy minerals within a water-laid sandstone. *Jour. Sedimentary Petrology*, vol. 3, no. 1, pp. 3-29, Apr. 1933.

Discusses the various factors which control the distribution of heavy minerals in natural sandstones. Differences in density and hardness of various minerals, differences in original size of various mineral grains in the source rock, the amount of abrasion that all grains have undergone during transportation, the different settling velocities of the various grains at the site of deposition, and the degree of sorting to which all grains were subjected are considered as factors which cause variations in the relative abundance of various minerals in different samples of deposits derived from the same source rock.

8. The force required to move particles on a stream bed. U. S. Geol. Survey Prof. Paper 189-E, pp. 121-140, illus., 1938.

Discusses movement of particles on a stream bed and theories of impact or momentum of water against a particle (sixth power law), the frictional drag upon surface of particle (critical tractive force) and differences in pressure between top and bottom of particle caused by gradient of velocity, (hydraulic lift). Theories based on laboratory experimental data by G. K. Gilbert are evaluated to prove the "sixth power law" valid for coarse sand and gravel but not fine sand and silt, provided "bed" velocities instead of mean velocities are employed. Evidence suggests that smaller particles are protected by laminar film of low velocity, but further data are needed to show forces which finally cause movement of fine sand and silt. Equations based on laboratory data allow reasonable estimates of maximum size of pebbles moved by certain large natural streams.

RUCKMAN, JOHN N.

1. Production of aggregate from river gravels in the Plains region. *Rock Prod.*, vol. 35, no. 8, pp. 20-23, illus., Apr. 23, 1932.

Discusses, in connection with the production of aggregate from river gravels in the Plains region of the United States, the sources of aggregate due chiefly to glacial erratics, the mechanical analysis of recent bars and "blue" gravels in the Kansas River, the utility as aggregate of stream gravels, and the characteristics of river-bed movement in streams of the Plains region. Notes conditions necessitating the operation of dredges in ponds in preference to river bed.

2. Production of aggregate from river gravels in the Plains region. *Rock Prod.*, vol. 35, no. 11, pp. 13-19, illus., June 4, 1932.

Describes, in connection with the production of aggregate from river gravels on the Plains region of the United States, the difficulties encountered in dredging materials due to continued deposition of river-borne materials, and methods of handling floating equipment.

3. Production of aggregate from river gravels in the Plains region. *Rock Prod.*, vol. 35, no. 14, pp. 22-25, illus., July 16, 1932.

Discusses, in connection with the production of aggregate from river gravels, the design and efficiency of centrifugal pumps and motors for pumps used to dredge sand and gravel in the Central Plains region.

RUEDEMANN, R.

1. (and Shoonmaker, W. J.). Beaver-dams as geologic agents. *Science* n. s., vol. 88, no. 2292, pp. 523-525, Dec. 2, 1938.

Discusses the physiographic importance of beavers as agents in aggrading smaller valleys below the size of navigable rivers. Cites examples in Lost Creek Valley, in Yellowstone Park, and in the vicinity east of Troy, N. Y., and of Made-

line, N. Y. Their work is characterized by complete aggrading of valley floors leaving a gently graded even valley plain horizontal from bank to bank. Fine silt gathered in beaver pools has produced rich farm land in the valleys of wooded areas of the northern half of North America.

RULE, G. K.

1. Soil defense in the Northeast. U. S. Dept. Agr., Farmers' Bul. 1810, 70 pp., 1938.

Pertains to soil losses through erosion. Outlines procedures and measures adopted by the U. S. Soil Conservation Service in cooperation with "the man on the land" to halt further losses of the remaining topsoil. Describes the nature and amount of soil removed by runoff water, and notes the effect of deposited silt on reservoir storage. Notes that of 11 dams, constructed on various streams in the farming community near Ithaca, N. Y., 7 are completely filled with silt, 3 are partially functioning, and the capacity of the Ithaca city water reservoir was reduced to 23 percent of its original capacity in 25 yr. as a result of silting. Outlines effects of channel silting on navigation on the Bush in northern Maryland and the Susquehanna and Patuxent Rivers. Estimates that Kings Mill Dam, on Kings Run, Lancaster County, Pa., washed out by heavy rains in 1934, had backed up 27,000 tons of topsoil through the years. The richest soil in deposit was located at the bottom and inferior soil was lying near the top.

RULE, RHODES E. See Sonderegger, A. L., 2.

RUPKEY, R. H. See Golze, A. R., 1; Stanley, J. W., 5.

RUSSELL, H. L. See Turneure, F. E., 1.

RUSSELL, ISREAL C.

1. Preliminary report on the geology and water resources of central Oregon. U. S. Geol. Survey Bul. 252, 138 pp., illus., 1905.

Deals with the geology and water resources of central Oregon. Includes a brief description of recent (probably dating back about 15 or 20 yr.) conditions of stream erosion due to denudation in the hills of Price Valley, Crook County, Oreg.

RUSSELL, R. DANA. See also Russell, R. J., 3.

1. Frequency percentage determinations of detrital quartz and feldspar. *Jour. Sedimentary Petrology*, vol. 5, no. 3, pp. 109-114, illus., Dec. 1935.

Describes certain types of detrital quartz grains which are difficult to distinguish from certain feldspars and presents a simple staining method for the accurate determination of the frequency percentage of the minerals which affords an immediate separation of the quartz from the other minerals.

2. The size distribution minerals in Mississippi River sands. *Jour. Sedimentary Petrology*, vol. 6, no. 3, pp. 125-142, illus., Dec. 1936.

Presents results of analyses to determine the size distribution of minerals in sediment samples collected from the bed of the Mississippi River. Samples show considerable variation in grain size and degree of sorting. Variations in grain size and degree of sorting in pairs of samples produce great differences in mineral composition making impossible the usual methods of accurate mineralogical comparison. Recommends a method of mineralogical comparison, suggested by Rubey, for use in studies wherein samples differ in average grain size or degree of sorting. States that studies of the size distribution of minerals in bed material of the Mississippi River are being undertaken with a view to determining the effect of transportation by the river upon the mineral composition of its bed load.

3. (and Taylor, Ralph E.). Roundness and shape of Mississippi River sands. *Jour. Geol.*, vol. 45, no. 3, pp. 225-267, illus., Apr./May 1937.

Presents results of studies with samples of Mississippi River sand collected from the bed of the river at intervals between Cairo and the Gulf to determine the effect of attrition during transportation upon the roundness and shape of the river sands and to determine whether a progressive sorting on the basis of shape exists in the river. Results of studies indicate that there is no evidence of rounding of sand grains

- due to attrition during transportation, fracturing and chipping produce an increase in angularity of grains rather than rounding them, and sorting seems to be a relatively unimportant factor in bed-load transportation, at least with respect to sand sizes.
4. Mineral composition of Mississippi River sands. Amer. Geol. Soc. Bul., vol. 48, pp. 1307-1348, illus., Sept. 1, 1937.
Presents results of studies on the mineral composition of the Mississippi River sediments collected from the bed of the river between Cairo, Ill., and the Gulf of Mexico. Selected samples have been studied to secure data on the mineralogy of the bed-load sediment and on the possible existence of progressive changes in mineral composition of bed load and bed material. The study affords definite evidence of the validity of the hypothesis that certain minerals are rapidly eliminated during transportation and their presence in sediments indicate proximity to source rock. Discusses the hypothetical effects of stream transportation upon mineral composition of transported bed load. Describes the method of collection and treatment of samples. Data on the mineral composition of the samples are given, and physical characteristics of the minerals are described. The effect of local differences in size of grain and degree of sorting on variations in mineral composition is considered. The persistence of detrital minerals in sediments is discussed.
 5. (and Taylor, Ralph E.). Bibliography of roundness and shape of sedimentary particles. Natl. Res. Council, Div. Geol. and Geog., Com. on Sedimentation, Rpt. 1936-37, pp. 65-80, Oct. 1937.
This bibliography of 87 references, plus 6 supplied by F. J. Pettijohn, includes most of the important articles on the roundness and shape of sedimentary particles published up to December 1935.
 6. Effects of transportation on sedimentary particles. In Trask, P. D., ed. Recent marine sediments; a symposium, pp. 32-47. London, T. Murby and Co., 1939.
Outlines present knowledge with respect to the effects produced upon sedimentary particles in transportation by the phenomena of sorting and abrasion. Discusses sorting action, with particular reference to locality of deposition (local) and to the direction of transportation (progressive), involving factors inherent in both transported material and the agent of transportation. Effects of abrasion on the size, shape, and mineral composition of sedimentary particles are discussed. "The effects of abrasion and sorting may lead to similar or to opposite results; in either case, studies of the effects of transportation under natural conditions are incomplete unless an attempt is made to distinguish between these factors and to evaluate their relative importance." Indicates possibilities to be considered in planning future research.
 7. [Review of] The examination of fragmental rocks, rev. ed., by Frederick G. Tickell. Jour. Sedimentary Petrology, vol. 9, no. 1, pp. 42-43, Apr. 1939.
Comments on Prof. Tickell's book (Tickell, F. G., 1) which deals with size analysis, preparation of samples, identification of minerals, optical methods of identification, etc. Notes that the book disregards modern techniques in laboratory methods developed in the 8 yr. since the first edition.
 8. [Review of] Study of materials in suspension, Mississippi River, by U. S. Waterways Experiment Station. Jour. Sedimentary Petrology, vol. 9, no. 3, pp. 134-135, Dec. 1939.
Reviews a paper (U. S. Waterways Expt. Sta., 20) which is a detailed study of sedimentary materials carried by the Mississippi River. Paper gives data on the sedimentary load of the Mississippi and gives data on sediment distribution at various points in the stream cross section for various velocities and river stages.
 9. Tables for the determination of detrital minerals. Natl. Res. Council, Div. Geol. and Geog., Com. on Sedimentation, Rpt. 1940-41, pp. 6-7, tables, Mar. 1942.
Presents tables for the determination of detrital minerals under the microscope. Various optical properties such as color, pleochroism, shape, indices, birefringence, elongation, extinction, optic sign, crystallography, and optic orientation are given for use in identification of detrital minerals.
- RUSSELL, RICHARD JOEL. See also Lougee, R. J., 1; Twenhofel, W. H., 7.
1. Physiography of lower Mississippi River Delta. La. Geol. Survey, Geol. Bul. 8, pp. 3-199, illus., Nov. 1, 1936.
Discusses the general physiography of the region and considers land forms such as natural levees and mudlumps. Treats such subjects as channels, meandering, sedimentation, suspended load, bed load, and submergence.
 2. Quaternary surfaces in Louisiana. Internatl. Geog. Cong. 15, Proc., vol. 2, pp. 406-417, 1938.
Discusses the probable origin of the Gulf coast terraces in Louisiana and Mississippi. Includes information on processes of delta formation at the mouth of the Mississippi River. States that the Mississippi Delta has not increased in area in the past century and that it has been mainly down-building, compensated by reciprocal movement of land rise not far interior from the coast.
 3. (and Russell, R. Dana). Mississippi River Delta sedimentation. In Trask, P. D., ed. Recent marine sediments; a symposium, pp. 153-177, illus. London, T. Murby and Co., 1939.
Discusses conditions of delta sedimentation by the Mississippi River, indications of Tertiary deltas in Texas and Louisiana, coincidence of Pleistocene deltas with present shore line, and the extent of the recent delta. Concentration of the sedimentary load of the Mississippi in the vicinity of active passes results in rapid subsidence causing subsequent marine deposition in delta-flank and subdelta-flank depressions. Discusses the characteristic pattern of delta sedimentation, natural levee formation, crevasse deposits, natural levee formation versus shoreline processes, the variability in character of sediments of the lower delta which indicates a relationship between the sedimentary type and the environment of deposition, the sorting phenomenon, delta structure, characteristic features of large deltas, and inter-fingering of marine and continental sediments.
 4. Louisiana stream patterns. Amer. Assoc. Petrol. Geol., vol. 23, no. 8, pp. 1199-1227, illus., Aug. 1939.
Discusses the variety of stream patterns in Louisiana which are dependent on such factors as load, grade, variations in stage, meander patterns, etc. These factors can be used to unravel flood-plain history. Comments on the significance of stream pattern.
 5. Quaternary history of Louisiana. Geol. Soc. Amer. Bul., vol. 51, no. 8, pp. 1199-1234, illus., Aug. 1, 1940.
Deals with the deposition of five Quaternary formations, Recent being the latest, in Louisiana, which were deposited in the Mississippi River system. Subsidence of the deltas has caused regional tilting and four of the Pleistocene formations are preserved as terraces. Notes that seven subdeltas of the latest Recent have been identified. Considers isostatic and structural implications. Treats of delta-flank depressions.
 6. (and Fisk, Harold N.). Isostatic effects of Mississippi River Delta sedimentation. Internatl. Geod. and Geophys. Union, Assoc. Geod. Gen. Assembly, 7, Washington, 1939, Proc., pp. 56-59, 1942.
Deals with the isostatic effects of sedimentation in the Mississippi Delta. Notes that the daily load reaching the lower delta-region of the Mississippi River averages about 2,000,000 tons; the earth's crust appears to yield under the load. Points out a tilting of formations which results from a coastal subsidence and what seems to be a compensating uplift inland. Evidence indicates weak condition for the earth's crust from the standpoint of yielding and subsiding under sedimentary load.

RUSSELL, RICHARD JOEL. - Continued

Notes warped terraces which displayed along the margins of the Mississippi indicate the strength of the earth's crust. Notes that delta-flank depressions form deep embayments and low territories.

RYVES, R. A.

1. Harnessing the Nile. *Civ. Engin.* [London], vol. 29, pp. 132-134, illus., Apr. 1934.

Deals with studies of the improvement of the Nile River system by the British Government. Recommends in conclusion that nature can be assisted in river regulation and control of deposition of silt by providing, among other things, outlets for lakes and diversions of affluent rivers.

SAEGER, C. M., JR. See Jackson, Clarence E., 1.
ST. LOUIS BOARD OF WATER COMMISSIONERS.

1. Report of the chief engineer. In *St. Louis Bd. Water Comms., Rpt.*, vol. I, pp. 19-39, 1865. Describes the proposed scheme of water purification at St. Louis. Briefly discusses, from an engineering standpoint, results of Col. Flad's experiments dealing with the sediment content of the Mississippi River at St. Louis, the volume-weight relationship of dried silt, and rate of settling of the suspended material.

ST. LOUIS WATER DEPT. SUPPLY AND PURIFYING DIVISION.

1. Report of the chemist. In *St. Louis Water Commr., Ann. Rpt.*...for the year ending Apr. 1, 1912, pp. 29-48, illus.

Describes water treatment operations at the St. Louis water works for the year ending Apr. 1, 1912. Includes discussion on causes of excessive turbidity and measures taken to reduce the turbidity of the Mississippi River supply. Data on turbidity and dissolved- and suspended-load determinations for the period of observation are given.

ST. PAUL ENGINEER DISTRICT SUB-OFFICE. See U. S. Interdepartmental Committee.

SALISBURY, E. F.

1. Influence of diversion on the Mississippi and Atchafalaya Rivers. *Soc. Civ. Engin., Trans.*, vol. 102, pp. 75-103, illus., 1937; also in *Amer. Soc. Civ. Engin., Proc.*, vol. 61, no. 9, pp. 1277-1305, illus., Nov. 1935.

Discusses the effects of unrestricted diversion at all stages from the Mississippi River into the Atchafalaya River. Gauge heights at points on both rivers for the same volume of discharge are analyzed. Analyses indicate that (1) at gauge stations along the Mississippi River where the flow is not subjected to unrestricted diversion, the same volume of water is now passing at the same elevation as in earlier years, and at these points the river is not silting, (2) in accordance with hydraulic theory, the Mississippi, below the point of diversion, increased its slope for the loss of volume diverted, and (3) the Atchafalaya River has conformed itself to hydraulic theory and decreased its slope as its volume increased due to diversion. Discusses, in connection with the study, the treatment of the silt load by a silt-bearing stream as an agency of adjustment to changed conditions.

Discussion: LEO M. ODOM, pp. 104-109, comments on the contentions deduced by Salisbury relative to the conformity of the Mississippi River to hydraulic theory as influenced by the diversion into the Atchafalaya River. E. W. LANE, pp. 109-117, notes Salisbury's contentions that there has been a decrease in discharge capacity of the Mississippi below Red River Landing due to silt deposits, resulting from diversion, which have reduced the channel areas, and that no corresponding decrease has occurred in the discharge capacity of the stream above Red River Landing. THE AUTHOR, pp. 117-122, comments on discussions mentioned above.

SALISBURY, ROLLIN D.

1. *Physiography*. Ed. 3, rev. 676 pp., illus. New York, Henry Holt and Co., 1931.

A textbook dealing with the various aspects of physiography. In the chapter entitled *Work of Running Water*, such subjects are treated as

rate of land degradation; erosional features; causes of deposition; location of alluvial deposits and the topographic forms, flood-plain meanders, and deltas.

SALYER, J. C.

1. Preliminary report on the beaver-trout investigation. *Amer. Game*, vol. 24, no. 1, pp. 6, 13-15, illus., Jan./Feb. 1935.

Presents results of an investigation relative to the effects of beavers on trout subsistence. Notes that beaver dams are the source of large quantities of fine impalpable silt, which, when deposited below dams, is injurious to food organisms and to trout eggs. Silt conditions in beaver ponds are not conducive to the successful spawning of trout.

SAMPSON, ARTHUR W.

1. (and Weyl, Leon H.). Range preservation and its relation to erosion control on western grazing lands. *U. S. Dept. Agr. Bul.* 675, 35 pp., illus., June 25, 1918.

Discusses erosion damages and factors determining the amount of erratic runoff and erosion. Notes the effect of silt on fish and other aquatic life. Comments on excessive erosion and debris deposition due to flood of July 28, 1912, at head of Ephraim Canyon and to flood of July 30, 1912, in Becks Canyon in the Manti National Forest, Utah. Gives preventative and remedial measures.

SAMPSON, H. C.

1. The Tana River region of Kenya Colony. *Roy. Soc. Arts Jour.*, vol. 84, no. 4333, pp. 92-107, illus., Dec. 6, 1935.

Gives a general description of the Tana River region of Kenya Colony, Africa. Tana River carries red clay in suspension and near its mouth collects silt as it cuts its banks. Irrigation development is only possible on upper Tana River, because the silt deposits in lower reaches raise the bed of the river, making necessary the raising of embankments and costly revetment work.

SANDERSON, EARL E.

1. Sedimentation of reservoirs in Ohio. *Ohio Water Resources Bd. Bul.* 17, 27 pp., illus., Apr. 1948. A summary of all available data on the sedimentation of reservoirs in Ohio. Includes information on reservoir silting for 27 reservoirs. Contains a bibliography dealing with reservoir silting, and specific reports on various reservoirs in Ohio. Discusses problems of sedimentation in reservoirs, such as economic aspects, control of reservoir silting, determining volume of sediment production, selection of reservoir site, capacity-watershed ratio, and pond sedimentation. Describes methods and presents data in some detail for the Lake White survey.

SANGER, K. J. See Campbell, F. B., 1.

SANKS, ROBERT L. See Bermel, K. J., 1.

SANTA BARBARA COUNTY ROAD DEPT.

1. Flood investigation report of the Santa Ynez River, Santa Barbara County, California. 124 pp. 1938. Report of a survey of the Santa Ynez River watershed in California. Gives flood, erosion, and sedimentation damages. Comments on silting in the Gibraltar Reservoir. Describes an investigation of a program of water-flow retardation and soil-erosion prevention as an aid to flood control; such a program is recommended for the Santa Ynez watershed.

SAPPER, KARL. See Krynine, P. D., 2.

SATHAPATHI, N.

1. Use of Westphal balance in sedimentation analysis. *Current Sci.*, vol. 16, p. 219, illus., July 1947. Discusses the adaption by the author of the Westphal balance for the mechanical analysis of soils using Oden's principle.

SAUCEK, EDWARD. See Mavis, F. T., 4.

SAUER, CARL O. See Bowman, I., 2.

SAUER, E. L. See Stall, J. B., 1.

SAVAGE, J. L.

1. Dams and hydraulics. *Engin. News-Rec.*, vol. 116, pp. 200-202, illus., Feb. 6, 1936.

Describes the construction of dams and allied structures, types of canal construction machinery, and includes notes on model testing. Includes two paragraphs on desilting works for the All-American Canal to remove 60,000 tons

of silt per day from 12,000 sec. ft. of diverted water by means of three double basins with rotating scrapers.

SAVARENSKY, A. D.

1. Peculiarities of erosion in the downstream pool of dams on mountainous rivers. North Caucasus Inst. Sci. Res. Hydrotechnic and Melioration, Jour., no. 1/2, pp. 23-27, 1934. In Russian. Translation on file at the U. S. Soil Conservation Service, Washington, D. C.

Discusses peculiarities of erosion in the downstream pool of supporting structures in mountainous rivers. Notes scour and considers preventative measures against scouring in the downstream pool. Gives various equations concerned with the problem.

2. Silting in the upstream pool of dams on mountainous rivers. North Caucasus Inst. Sci. Res. Hydrotechnic and Melioration, Jour., no. 1/2, pp. 38-?, 1934. In Russian. Translation on file at the U. S. Soil Conservation Service, Washington, D. C.

Discusses the effect the silting of the upstream pool in mountainous rivers may have on head development dams. Describes observations on the Terek River and conditions of silting of the upstream pool.

SAVELIEV, S. F.

1. Experimental investigations of the headworks and intake structure of the Dzoragues Hydroelectric Plant, the silting of its pondage reservoir and the motion of bottom silt at the intake. Sci. Res. Inst. Hydrotechnics, Trans., vol. 9, pp. 122-142, 1933. In Russian with abstract in English. Translation on file at the U. S. Soil Conservation Service, Washington, D. C. and the University of Minnesota, Minneapolis, Minn.

Describes the model, the procedure, and the results of studies.

2. Experimental study on a model of the work of head structures of Adjaris-Zhaly hydroelectric plant. Sci. Res. Inst. Hydrotechnics, Trans., vol. 10, pp. 69-102, illus., 1933. In Russian with English abstract.

Presents results of experimental studies relative to the work of the head and inlet structures, the processes of sedimentation in a settling basin, and desilting by sluicing at the Adjaris-Zhaly hydroelectric plant, U. S. S. R.

SAVESON, I. L.

1. (and Overholt, Virgil). Stream bank protection. Agr. Engin., vol. 18, no. 11, pp. 489-491, illus., Nov. 1937.

Discusses the erosion and protection of stream banks, the field surveys made by the U. S. Soil Conservation Service, and detailed model studies conducted at Ohio State University. Process of stream-bank erosion is described. For protection of streams the use of a good stand of willows, cottonwood, sycamore, or black locust to hold outside bank of stream in place and prevent caving or sloughing is recommended. Willow is the best type of vegetation, and of the willows, white and black willows are preferable to crack and bar willow, because the limbs of the latter are shed into the stream, float downstream and lodge in unfavorable locations.

SAVILLE, THORNDIKE.

1. Water-power investigation of Deep River. N. C. Geol. and Econ. Survey, Econ. Paper 54, 42 pp., illus., 1924.

Presents results of a complete study of developed and potential power on the Deep River, N. C. Includes discussions on stream flow, silting conditions in existing power ponds, and methods of silt control and removal. The removal of silt by pumping, by floating dredge, sluicing, blasting in time of flood, and excavation by drag line scraper is considered. The advantages of high storage dams provided with capacities for silt storage, and furnished with flushing facilities, for erosion control practices on watershed are discussed in connection with the control of silt in the Deep River.

2. Methods of overcoming silting of reservoirs outlined [extract]. Engin. News-Rec., vol. 93, no. 8, p. 306, Aug. 21, 1924.

Outlines possible methods of desilting ponds and reservoirs on the Deep River in North

Carolina and refers to The Waterpower Investigation of the Deep River (Saville, T., 1). Discusses the method of (1) pumping by floating dredge, (2) sluicing through openings in dams, (3) blasting in time of flood, and (4) excavation by dragline scraper, and the effect of high-storage dams located at the headwaters in preventing silting of low-storage reservoirs below. Value of reforestation and erosion control is cited.

3. The water supply of Caracas, Venezuela, with notes on conditions affecting water supplies of the country. New England Water Works Assoc. Jour., vol. 42, no. 3, pp. 303-338, illus., Sept. 1928.

Results of investigations for obtaining an additional water supply for the city of Caracas, Venezuela. Briefly notes conditions of sediment transportation and deposition in the Macarao River and in the intake canal of the Macarao supply. The effectiveness of sand traps in the canal is reported. Describes the physical and chemical characteristics of Macarao River water.

4. Deficiencies in present water resources information. Amer. Water Works Assoc. Jour., vol. 27, no. 8, pp. 964-976, Aug. 1935.

Discusses deficiencies in present water resources, noting the need for careful study of soil erosion in order to plan control measures to avoid silting up of streams and reservoirs. Reports that the silting up of harbors as a result of erosion has a detrimental effect on fishing and on the shellfish industry.

5. Basic principles of water behavior. In Headwaters, control and use...Upstream Engin. Conf., Sept. 22-23, 1936, pp. 1-10, illus. Washington, 1937.

Discusses the hydrologic cycle. Deals with specific problems in the hydrology of upstream engineering.

Discussion: WILLIAM PETERSON, pp. 10-14, gives data on silt deposited by the Colorado River at Yuma, 1903-35. LEROY K. SHERMAN, pp. 14-15, comments on science of hydrology.

SAYLES, R. W.

1. Seasonal deposition in marine waters. Natl. Res. Council, Div. Geol. and Geog., Com. on Sedimentation, Rpt. (1922-23), pp. 61-64, 1923.

Describes experiments to determine actual conditions of deposition in salt water, rate of settling of clay particles in fresh and salt water, and effect upon deposition of glacial stream water entering into salt water. Considers the importance of temperature, density, wind, bottom currents, and shape of basin, with reference to deposition study.

SCHAANK, E. M. H.

1. (and Slotboom, G.). Enkele mededeelingen betreffende de zandbeweging op den Neder-Rijn (Notes on sand movement in the Lower Rhine). Ingenieur, no. 51, pp. 1-5, 1937. In Dutch. Translation on file at the U. S. Soil Conservation Service, Washington, D. C.

Discusses sand movement on the Lower Rhine. A suspended-load trap (C. Cramers) and bed-load trap (Arnhem) were used for measurements. Checks known formulas concerned with the problem. Gives results of study. Effects of dredging cause the level of the river bottom and the surface to vary about 4 cm. per yr. About 230,000 cu. m. of sediment are transported for a normal year.

SCHAFFERNAK, FRITZ.

1. Die Theorie des Geschiebetriebes und ihre Anwendung (The theory of bed-load transport and its application). Oesterr. Ingen. u. Architekten Verein, Ztschr., no. 11/12, 1916. In German. Translation on file at the U. S. Soil Conservation Service, Washington, D. C.

Deals with the development of the theory of bed-load transportation and a universal bed-load transportation law based on the equation of Du Boys. Gives various fundamental equations. Examines the experimental determinations of critical shear stress and the bed-load number of Du Boys. Comments on fluid friction as the chief factor in the formation of the form of unprotected river profiles. Notes the determination of bed-load retention by fixed weirs.

SCHALK, MARSHALL. See Collins, R. F., 1.
SCHAUB, EUGENE.

1. A small hydro-electric plant in Utah rehabilitated. *Engin. News-Rec.*, vol. 98, no. 7, pp. 276-279, illus., Feb. 17, 1927.

Describes the rehabilitation of a small hydro-electric plant on Logan River, Utah. Notes use of V-shape trough, at right angles to direction of flow and having lower side contracted into a nozzle to trap sand and silt. Removal of accumulation is through sluice gates.

SCHEFFER, P. M.

1. The beaver as an upstream engineer. *Soil Conserv.*, vol. 3, no. 7, pp. 178-181, illus., Jan. 1938.

Discusses the value of the beaver as an engineer, agronomist, and forester in soil and water conservation. A survey made in 1937 to determine work accomplished by beavers placed in Mission Creek, near Cashmer, Wash., showed that they had constructed 60 dams in more than 5 miles of waterway. Most ponds were silted with fine sandy soil. Presents table giving measurements of 22 beaver dams, and amount of silt retained behind each dam in the lower 2,000 ft. of the East Branch of Mission Creek.

SCHEIFELE, O. S.

1. Protection of river banks and levees. *Canad. Engin.*, vol. 54, no. 1, pp. 119-123, illus., Jan. 10, 1928.

Describes a protective device in which angular willow-tree planting is used to prevent erosion and bank slides. Advantages of the system are discussed. Included are illustrations showing the system as carried out on the Mississippi and Missouri Rivers and on the Erie Canal near Clyde, N. Y.

SCHIFF, LEONARD. See Anderson, H. W., 1.

SCHILLING, H. M.

1. Sand sluicing operations, west extension, Umatilla project. *Reclam. Rec.*, vol. 10, no. 9, pp. 420-422, illus., Sept. 1919; [abstracts], *Engin. and Contract.*, vol. 52, no. 20, pp. 559-560, illus., Nov. 12, 1919; *Engin. News-Rec.*, vol. 83, no. 21, p. 998, Dec. 11-18, 1919.

Describes means of removing wind-blown sand from the west extension of the main canal of the Umatilla irrigation project by use of movable template, and means employed to prevent wind from blowing sand into the canal.

SCHLECHT, W. W. See Mead, E., 4.

SCHLICK, W. J. See also Jones, L. A., 1.

1. Erosion of the dredged channel of the West Fork of the Des Moines River through Palo Alto County and the maintenance problems which are developing. *Iowa Engin. Soc., Proc.*, 42, pp. 45-60, illus., 1930.

Presents results of observations on changes in the dredged channel of the West Fork of the Des Moines River through Palo Alto County. Character and extent of erosion, present condition of the channel, and need for channel maintenance discussed.

SCHMITT, WALDO L. See Sumner, F. B., 1.

SCHOBINGER, GEORGE.

1. Colorado River siphon. *Amer. Soc. Civ. Engin., Trans.*, vol. 77, pp. 1-34, illus., Dec. 1914.

Describes construction of the Colorado River siphon near Yuma, Ariz., to conduct irrigation waters to Yuma Valley and Mesa. Variations between extreme flood and low-water surface elevations of the Colorado River are discussed, noting that during low-flood years the 30-ft. silt blanket, dropped by the falling river of the preceeding years, is partly removed. Notes that velocity in the siphon is slightly greater than silting velocity and that little or no silting has taken place.

Discussion: H. T. CORY, pp. 35-36, indicates the possibility of siphon silting up, even though removal of all but finer silt at Laguna Dam is effective, and indicates that a considerable percentage of suspended silt is probably deposited in a 14-mile canal leading to the siphon. THE AUTHOR, pp. 36-37, notes that there is no danger of the siphon silting up. Results of tests indicate that the Laguna Dam removes from 30 to 60 percent of the silt carried by the river; canal leading to siphon and siphon retain 95 percent of its silt in suspension throughout its distance. Mode of operation of the siphon permitting weekly draining and cleaning is noted.

SCHODER, ERNEST W.

1. [Review of] *Die wasserbaulaboratorien Europas; entwicklung aufgaben ziele* (European River-Hydraulic Laboratories), by Conrad Matschoss, H. Engel, R. Winkel, T. Rehbock, and J. R. Freeman. *Engin. News-Rec.*, vol. 96, no. 20, pp. 821-822, May 20, 1926.

Notes that the book is a volume on laboratories in Europe for the study of river hydraulics; half of which is given to the study of problems and their relation to practice. Describes experimental results in summaries. Points out that at the ends of chapters there are 11 bibliographies totaling 175 references to technical literature which are mostly German publications.

SCHOENLEBER, L. H.

1. Compilation of rainfall and runoff from the watersheds of the Missouri Valley Loess Region Conservation Experiment Station, Clarinda, Iowa, 1934-38. *U. S. Soil Conserv. Serv., SCS-TP-31*, 12 pp., illus., tables, graphs, May 1940.

A compilation of hydrologic data on small watersheds at the Conservation Experiment Station, Clarinda, Iowa. Soil loss in runoff was determined by the use of a Ramser silt sampler and silt boxes.

SCHOKLITSCH, ARMIN.

1. Über Schleppkraft und Geschiebebewegung (On traction and bed-load movement). 66 pp. Leipzig und Berlin, Wilhelm Engelmann, 1914. In German. Translation on file at the U. S. Soil Conservation Service, Washington, D. C., and the Hydraulic Laboratory Section, National Bureau of Standards, Washington, D. C.

Describes experiments which consider the traction of bed load and its movement. Considers the equilibrium of bed load. Gives various formulas concerned with the problem and results of the study.

2. Über die Verklünerung der Geschiebe in Flussläufen (On the reduction in bed-load grain size by transportation in streams). *Akad. der Wiss. Wein. Math.-Nat. Kl., Sitzber. Abt. 2a*, vol. 142, no. 6, pp. 343-386, illus., 1933. In German. Translation on file at the Engineer Department Research Centers, U. S. Waterway Experiment Station, Vicksburg, Miss.

Discusses reduction in bed-load sizes by abrasion, solution, attrition, collusion and weathering. Reverifies Sternberg's equation for bed-load abrasion. Points out that there is no reason for replacing Sternberg's equation by Dull's empirical equation.

3. Der Geschiebetrieb und die Geschiebefracht (Bed load and the rate of bed-load transportation). *Wasserkr. u. Wasserwirtsch.*, vol. 29, no. 4, pp. 37-43, illus., Feb. 16, 1934. In German. Translation on file at the U. S. Soil Conservation Service, Washington, D. C.

Presents formulas for the calculation of bed load for natural streams with natural bed-load mixtures. Discusses the relationship between bed load and tractive force, movement of bed load composed of uniform particles, movement of bed load composed of mixed particles, distribution of bed load over the bottom, variable bed load and calculation of the rate of bed-load transportation in natural water courses.

4. Staurationverlandung und Kolkabwehr (Siltation of reservoirs and scour prevention). 178 pp., illus. Wien, Julius Springer, 1935. In German. Translation on file at the U. S. Soil Conservation Service, Washington, D. C., and at the California Institute of Technology, Pasadena, Calif.

Deals with river debris and its movement, the silting of reservoirs, and the prevention of scour and the dissipation of energy at weirs in European streams. Considers bed-load properties, the manner and rate of bed-load movement, and the reduction in size of bed materials by abrasion, wear, etc.; the movement of suspended matter, factors affecting conditions of suspended-sediment transportation, sampling of suspended load, and volume-weight relationship of deposited sediment. Discusses conditions of bed- and suspended-load deposition in reservoirs, observed data on conditions and

- rates of silting in some European reservoirs, movements of ice in a reservoir, methods for the prevention of silt accumulations in reservoirs, the influence of reservoir silting upon the water surface of a reservoir, and retrogression below dams subsequent to bed-load deposition in a reservoir.
5. Hydraulic structures, translated by Samuel Shulits. 2 vols., illus. New York, Amer. Soc. Mech. Engin., 1937.
Deals with the subjects of meteorology, hydrology and hydraulics, soil and soil mechanics, building materials of hydraulic structures, water-supply engineering, sewage, dams, outlet works, and canal intake works, hydroelectric plants, reclamation, river engineering, and waterways engineering. Includes discussions on bed load and suspended load of watercourses, on the river channel, and on the improvement of streams. Consideration is given to the transporting force of water; the character, nature, and behavior of bed load and suspended load in transport in flowing water; bed-load sorting; rate of bed-load movement; bed and suspended load estimates and measurements; stream meandering; shifting beds in streams; action of water at bends; factors affecting stream slope; effect of cut-offs on river profile; advance of deltas; silting in reservoirs; aggradation in streams above dams; correction of mountain torrents by stabilization of slopes; protection of slopes and banks, stabilization of channel bottom, and channel stabilization in debris cone areas; correction of mountain streams; and regulation of alluvial rivers.
- SCHOUTENS, W. See Van Nieuwenburg, C. J., 1.
- SCHRAMM, EDWARD.
1. (and Scripture, E. W., Jr.). The particle analysis of clays by sedimentation. Amer. Ceramic Soc. Jour. vol. 8, pp. 243-252, illus., Apr. 1925.
Discusses the quantitative application of the sedimentation method to the determination of particle distribution of clays in a dispersed state.
- SCHROEPFER, GEORGE J. See Slade, J. J., 1.
- SCHUHMAN, R. See Dobbins, W. E., 1.
- SCHULL, CHARLES A.
1. The formation of a new island in the Mississippi River. Ecology, vol. 3, no. 3, pp. 202-206, illus., July 1922.
Describes the formation of an island in No. 5 Chute of the Mississippi River; a result of deposited sediment caused by the obstruction of a large stranded barge to receding flood currents, April 1913. Island was built by not more than a dozen periods of deposition. Causes of excessive deposits on island are noted.
- SCHULTZ, CHARLES. See Taylor, T. U., 6.
- SCHULZ, EDWARD H.
1. The development of regulation works and the use of concrete in the improvement of the Missouri River. Military Engin., vol. 4, no. 18, pp. 683-716, illus., Nov. 1912.
Describes features of the Missouri River, and estimates that 400,000,000 tons of sediment is carried annually into the Mississippi River. Notes means of channel improvement by snagging, by bank protection and by channel contraction. Describes in detail various steps of the progress made in methods of bank protection leading to present improvements. Discusses works at various locations of Missouri, types of bank protection, operations, and costs.
 2. Concrete dikes and bank protection on the Missouri River [abstract]. Engin. News, vol. 68, no. 26, pp. 1197-1201, illus., Dec. 26, 1912.
Abstract from paper describing the use of the concrete dike and bank revetment on the Missouri River (Schulz, E. H., 1). Discusses use, details of construction, costs, and effectiveness of concrete dikes and revetment at Elwood Bend, above St. Joseph, Mo.; on Republican River, above Ft. Riley, Kans.; and on the left bank of the Missouri River, above St. Joseph, Mo. Authorized construction by the War Department of combined willow mattress and concrete revetment for needed bank protection at Pelican Bend, Gasconade, and Berger on the Missouri River is noted.
3. The improvement of the mouth of the Mississippi River. La. Engin. Soc., Proc., vol. 2, no. 6, pp. 329-340, illus., Dec. 1916.
An address briefly discussing conditions of sediment transportation and deposition at the mouth of the Mississippi. Describes existing revetment and dredging work and proposed construction of jetties to insure navigable channels through the passes.
 4. The Passes of the Mississippi River. Prof. Mem., vol. 9, no. 44, pp. 135-169, illus., Mar./Apr. 1917.
This article deals with the hydraulics of the Passes of the Mississippi River, existing works at Passes, and proposed improvements. Includes discussion on sediment determinations at the mouth of the Mississippi, distribution and chemical and mechanical analysis of deposits, mud lump conditions, rate of advance of bars, and the maintenance of the Passes by dredging.
 5. Some hydraulic problems of the Mississippi River. West. Soc. Engin. Jour., vol. 33, no. 6, pp. 288-296, illus., Feb. 1928.
Describes various hydraulic problems relative to improvements of the Mississippi River. Considers, among other problems, conditions of bank caving in the lower Mississippi, sediment transportation and deposition, and dredging. Notes that sediment content in Mississippi was found to equal 1/1500 by weight and 1/2900 by volume; total sediment carried to Gulf was estimated at 268 sq. miles.
 6. Some hydraulic problems affecting flood prevention work on the Mississippi. Engin. and Contract., vol. 67, no. 9, pp. 447-450, Sept. 1928.
Discusses various problems of flood control on the Mississippi River. Includes brief discussions on caving banks and revetments, sediment carried by water, and dredging on the lower Mississippi River. Notes that total amount of bank caving on lower river is 400,000,000 cu. yd. per yr. Sediment is found to equal 1/1500 by weight and 1/2900 by volume of discharge. The banks of the Southwest Pass at times advanced at rate of 1 mile in 20 yr. Estimates indicate an annual delta sediment deposit averaging 1/1000 in. in thickness. Dredging to maintain navigation amounts to about \$600,000 per yr.
- SCHURECHT, H. G.
1. Sedimentation as a means of classifying extremely fine clay particles. Amer. Ceramic Soc. Jour., vol. 4, no. 10, pp. 812-821, illus., Oct. 1921.
Describes a method used to determine the rate of settlement of clay particles (as small as 0.0001 mm.) by measuring the suspended weights of a glass plummet suspended in a clay slip at different intervals of time. Results of tests are given. Advantages of the plummet sedimentation method are outlined.
- SCHUYLER, JAMES DIX.
1. The construction of the Sweetwater Dam. Amer. Soc. Civ. Engin., Trans., vol. 19, pp. 201-217, illus., Nov. 1888.
Describes construction of Sweetwater Dam on the Sweetwater River, Calif. Includes one paragraph noting that the dam might be expected to fill with sediment in 1000 yr. Samples of water in Yuba, Bear and American Rivers, yielded an average of about 1/2 percent of sediment. If Sweetwater River was as heavily charged, the reservoir might fill in 200 yr.
 2. The influence of forests upon storage reservoirs. Forester, vol. 5, no. 12, pp. 285-288, Dec. 1889.
Discusses the effects of vegetative cover upon reservoir storage depletion due to silting. Notes loss in capacity of Sweetwater Reservoir of 5 percent during 11 years of its existence, due to accumulations of silt.
 3. Reservoirs for irrigation. U. S. Geol. Survey, Ann. Rpt., 18, pt. 4, pp. 617-740, illus., 1897.
Presents details of construction of various irrigation reservoirs in the United States. Notes briefly the reliance on the process of silting to prevent reservoir leakage in the proposed Lytle Creek Dam, Calif. Observations on the rate of silting of the Sweetwater Dam, Calif., are briefly given. Filling is at the rate of 1 percent every 6 yr.

4. The silt deposit behind the Austin Dam and the relation of silt deposits to storage reservoirs [letter to editor]. *Engin. News*, vol. 43, no. 25, p. 410, June 21, 1900.
Notes that deposits in reservoir behind Austin Dam amounted to 41.5 percent of capacity of reservoir in first 4 yr. after completion of dam. Estimates that silt content of the Colorado River is equivalent to about 0.25 percent of the total volume of water received in reservoir during these 4 yr. Calls attention to the fact that Sweetwater River, Calif., carries an average of more than 0.5 percent of silt and that deposits behind Sweetwater Dam amounted to 900 acre-feet in 13 yr. At this rate it would take 312 yr. to fill the basin with silt. States that Austin Reservoir has silted rapidly because its capacity was very small compared with the annual discharge of its drainage area. The capacity of reservoirs on silt-bearing streams should be equal to or greater than the normal mean annual runoff of their respective streams.
 5. Reservoirs for irrigation, water-power, and domestic water-supply. 414 pp., illus. New York, John Wiley and Sons, 1901.
A technical book giving examples, methods and plans of construction of various rock-fill, hydraulic-fill, masonry, and earthen dams in the world. Includes discussion of available water supply for irrigation in various arid sections of America, the distribution and use of water, rainfall and runoff, and evaporation from reservoirs. Includes information on silting in Sweetwater Reservoir, Calif., Lake Austin, Tex., and the proposed Elephant Butte Reservoir, N. Mex. Describes desilting methods used for Spanish reservoirs.
 6. The extension of the Sweetwater Dam. *Engin. News*, vol. 65, no. 13, pp. 369-371, illus., Mar. 30, 1911. Describes details of construction of an extension of the Sweetwater Dam, San Diego, Calif. Includes one paragraph noting reduction in capacity of reservoir of nearly 10 percent in 22 yr. Extension is made to increase capacity.
- SCHWENNESEN, A. T.
1. Ground water in the Animas, Playas, Hachita, and San Luis Basins, New Mexico. U. S. Geol. Survey, Water-Supply Paper 422, 152 pp., illus., 1918.
Presents results of a survey of the potential ground water resources of Grant County, N. Mex. Includes brief discussion on the origin and character of stream-deposited material forming the alluvial slopes of the region.
- SCHWEYER, H. E.
1. Measurement of particle-size distribution by optical methods; effect of light of different wave lengths. *Indus. and Engin. Chem., Analyt. Ed.*, vol. 9, no. 5, pp. 211-212, illus., May 15, 1937.
A study of the effect of light of different wave lengths upon the turbidity-concentration of suspensions of white and colored mineral powders. A Wagner turbidimeter was used. Believes that an understanding of the selective absorption of light will aid in the use of optical methods of measuring particle-size distribution.
- SCIMENI, ETTORE. See Bermel, K. J., 1.
- SCOBEY, FRED C. See also Fortier, S., 2; Grover, N. C., 12.
1. The flow of water in wood-stave pipe. U. S. Dept. Agr. Bul. 376, 87 pp., illus., 1916.
Discusses in general the problems concerned with the flow of water in wood-stave pipes; gives formulas for flow of water, description of pipes, Kutter's formula applied to wood-stave pipes, and their capacity. Points out that wood-stave pipes intended to convey silty water should be designed for a working velocity of from 5 to 10 ft. per sec. to avoid erosion of pipe and to carry out sand.
- SCOFIELD, CARL S. See also Grover, N. C., 12.
1. Quality of water of the Rio Grande basin above Fort Quitman, Texas. U. S. Geol. Survey, Water-Supply Paper 839, 294 pp., 1938.
Report presents detailed analytical data on the chemical composition of stream waters in the Rio Grande basin above Ft. Quitman, Tex.
- Tabulated analyses include some silt determinations.
2. Quality of water in upper Rio Grande basin. U. S. Natl. Res. Com., Region. Planning, pt. 6, vol. 1, pp. 429-466, Feb. 1938.
Summarizes and interprets results of a comprehensive investigation relative to the quality of waters in the upper Rio Grande basin, above Ft. Quitman, Tex.
- SCOTT, W. A.
1. Flood control work in Washington. *Engin. World*, vol. 14, no. 7, pp. 23-28, illus., Apr. 1, 1919.
Describes conditions necessitating flood control work on the Puyallup and White Rivers in Washington and presents a description of the developed flood control project. Includes brief description of types of bank protection works used as part of the project.
- SCRIPTURE, E. W., JR. See Schramm, E., 1.
- SEARS, PAUL B.
1. Silting in lake region is a vital problem facing agriculture and the fishing industry. *Ohio State Grange Monthly*, vol. 47, no. 7, p. 1, illus., July 1944.
Notes the effect of silting on fish in southern Lake Erie, and loss of topsoil by farms in that region. Treats briefly protective measures.
- SEAVY, LOUIS M. See also Brown, C. B., 9.
1. Sedimentation survey of Arrowrock Reservoir, Boise, Idaho. 43 pp., illus. Denver, Colo., U. S. Bur. Reclam., 1948.
Gives the results of an investigation of reservoir sedimentation in Arrowrock Reservoir on the Boise River, near Boise, Idaho. Determines the effect of sedimentation on the Arrowrock Reservoir, and in the design, operation, and useful life of proposed reservoirs. Methods of making the survey are given. Suspended load and mechanical analysis are included. Various types of maps, charts, etc. are given. Results are summarized.
 2. Sedimentation survey of Guernsey Reservoir, Guernsey, Wyoming. 41 pp., illus. Denver, Colo., U. S. Bur. Reclam., 1948.
Study to obtain data on notes of sedimentation in the Guernsey Reservoir near Guernsey, Wyo. Gives basic data for estimating rates of sedimentation in other existing reservoirs than those proposed by the U. S. Bureau of Reclamation. Notes the probable distribution of sediment within the reservoir. Suspended-load measurements and mechanical analyses of sediments are included. Various maps are included in the report. Summarizes results of study. Describes methods used in making the survey.
 3. Sedimentation survey of Tongue River Reservoir, Sheridan, Wyoming - Decker, Montana. 35 pp., illus., tables and graphs. Washington, U. S. Bur. Reclam. Branch Project Planning, Hydrology Div., Sedimentation Sect., 1949.
Presents the results of a reservoir sedimentation investigation in the Tongue River Reservoir on the Tongue River in Montana. The purpose of the survey was to obtain basic data in order to establish a sediment index for mountain drainage areas in Region 6 of the U. S. Bureau of Reclamation which would be used as an aid in planning sediment storage space for proposed reservoirs in the Missouri River basin. Gives results of mechanical analyses of sediment, distribution of sediment, and notes that the reservoir has a trap efficiency of 95 percent. Notes that the annual sediment production rate per square mile of drainage area is 0.19 acre-feet, the loss of reservoir capacity is slightly less than 0.5 percent per yr. Sedimentation has reduced the storage capacity of the reservoir by 4.24 percent or a loss of 3,071 acre-feet.
 4. Sedimentation surveys of Elephant Butte Reservoir, Rio Grande project, New Mexico-Texas. 36 pp., illus. Denver, Colo., U. S. Bur. Reclam., 1949.
Summarizes the data acquired during previous surveys of Elephant Butte Reservoir on the Rio Grande near Hot Springs, N. Mex. Presents the results of an investigation of sedimentation in Elephant Butte Reservoir during 1947. The objectives of the investigation were to obtain

data for preparing a new area-capacity curve to provide information needed in porportioning the Rio Grande water under the Rio Grande Pact and to compare the sediment rate for the drainage area contributing directly to the reservoir from its sides with the rate of sedimentation for the total drainage area of the reservoir. Presents data on the above-crest sediment deposits between the head of the reservoir and San Marcial, N. Mex. Estimates the bed load or the unmeasured load passing the San Marcial station. Includes data on suspended load.

SEDDON, JAMES A.

1. Some considerations of the relation of bed to the variables in river hydraulics. *Assoc. Engin. Societies Jour.*, vol. 5, no. 4, pp. 127-134, illus., Feb. 1886.

A technical paper advancing some conclusions, based on experimentation, of relation to the effect of various hydraulic forces upon changes in cross section in alluvial streams.

2. Notes on sediment observations of 1879 at Saint Charles, Missouri. *U. S. Engin. Dept., Rpt.*, pt. 4, pp. 3090-3096, 1887.

Contains data on sediment observations made 600-1000 ft. above the Saint Charles Bridge, Saint Charles, Mo., during 1879.

3. Clearing water by settlement-observations and theory. *Assoc. Engin. Societies Jour.*, vol. 8, no. 10, pp. 477-492, illus., Oct. 1889.

Presents results of experiments and observations on the rate of settling of sediment, with a view to the design of settling basins for the St. Louis waterworks extension.

SEGUR, A. B.

1. Notes on three irrigation projects in the Punjab, India. *Engin. News*, vol. 65, no. 20, pp. 585-588, illus., May 18, 1911.

Describes three irrigation projects in the Punjab, India. Includes one paragraph giving Kennedy's formulae to determine canal section, maximum height of silt, and maximum depth of scour for adequate canal design.

2. River control in India. *Purdue Engin. Rev.*, no. 8, pp. 97-104, illus., 1912.

Describes the Bell bund system of river control as practiced in India.

SEIGFRIED, J. H.

1. Silt deposits and methods of elimination. *Northwest Elect. Light and Power Assoc., Tech. Sect., Proc.*, 4, pp. 113-120, illus., 1927.

Discusses methods for the elimination of silt from hydraulic plants. Considers briefly results of G. K. Gilbert's experiments on the movement of solid matter by running water as they concern silt elimination. Factors involved in the design of suitable apparatus for the removal of silt are considered. Describes and discusses the efficiency of silt removal apparatus at several hydraulic plants on the White, Sandy, and Hood Rivers in Oregon, and on the Puyallup River in Washington.

SEILER, J. F.

1. Tree retards protect bridge. *Successful Methods*, vol. 4, no. 7, pp. 14-15, illus., July 1922.

Describes details of construction of the Torrington Bridge across the North Platte River at Torrington, Wyo. Notes the use of tree retards on south bank of stream to protect and build up the original bank.

SELLEW, FRANCIS L. See also Cory, H. T., 2.

1. The Colorado River siphon at Yuma, Arizona. *Engin. News*, vol. 68, no. 9, pp. 377-385, illus., Aug. 29, 1912.

Discusses the Colorado River siphon at Yuma, Ariz. Describes scheme for diversion of Colorado River and gives characteristics of the river and delta. Gives general description of siphon and construction methods. Notes effect of Colorado silt on canals, and in sealing openings in roof of old tunnel used to divert water for domestic use under the Colorado River. Gives data on alluvial deposits in the Colorado Delta.

SELMO, LUIGI.

1. Removal of silt from the Lete Reservoir. *Energia Elettrica*, vol. 7, no. 6, pp. 515-519, illus., June 1930. In Italian. Translation on file at the U. S. Soil Conservation Service, Washington, D. C.

Discusses the problem of the removal of silt from Lete Reservoir in Italy. Describes the method used. Gives data on sedimentation in the reservoir.

SEN GUPTA, D. N.

1. Tortuosity of rivers and their training by means of embankments. *India Cent. Bd. Irrig. Pub.* 11, pp. 77-84, illus., 1936.

Deals with the control of tortuosity of rivers in Bengal. Conditions of tortuosity are described, and methods of river training by means of embankments are considered.

SENOUR, CHARLES.

1. River navigation extended by open-channel expedients IV. Soil characteristics of bed and banks determine improvements. *Civ. Engin.*, vol. 16, no. 11, pp. 492-493, Nov. 1946.

Discusses the effects of soil characteristics of bed and banks in determining improvements.

2. New project for stabilizing and deepening lower Mississippi River. *Amer. Soc. Civ. Engin., Trans.*, vol. 112, pp. 277-290, illus., 1947; also in *Amer. Soc. Civ. Engin., Proc.*, vol. 72, no. 2, pt. 1, pp. 145-158, illus., Feb. 1946.

Discusses a new project for stabilizing and deepening the lower Mississippi River between Cairo, Ill., and Baton Rouge, La. Model studies were used to help develop the length of revetment needed to stabilize the river. Notes the need of 230 additional miles of bank revetment. Gives a condensed history of the development of present flood control plans. Summarizes the geologic investigations of the area.

Discussion: CHARLES W. OKEY, p. 291, makes comments on the plan by the Corps of Engineers for stabilizing the Mississippi. F. NEWHOUSE, pp. 291-293, notes erosive force of the river and use of revetments. Notes extent of the cross section revetted upon the Mississippi River, and disadvantages inherent in revetment of banks alone. GERARD H. MATTHES, pp. 293-294, treats the subject of the stability of the river. Makes observations contrasting the Mississippi and Mesopotamian alluvial valleys. Gives an explanation of the term "poised." THE AUTHOR, pp. 294-297, comments on points presented by the discussers and gives additional information concerning stabilizing the Mississippi.

3. Stabilization of banks of streams of the lower alluvial valley of the Mississippi River. *Fed. Inter-Agency Sedimentation Conf.*, Denver, 1947, *Proc.*, pp. 185-193, illus., 1948.

Considers the stabilization of banks of streams on lower alluvial valley of the Mississippi River. Gives briefly the past history of the lower Mississippi. The meander belt of the Mississippi is taken into consideration. Various types of revetments and effects are noted. Use of pile dikes on the Arkansas and Red Rivers is mentioned, and use of cut-offs to relieve caving banks is pointed out.

Discussion: WILLIAM H. BERRY, pp. 193-194, notes the use of a flexible type jetty known locally as "live willow spider," on the Navajo Reservation. JOHN T. O'BRIEN, pp. 194-196, describes the use of rail and wire or pipe and wire fences as revetments for many intermediate and small-sized streams in the Southwest, especially California. E. G. STEPHENSON, pp. 196-199, comments on use of pile dike and revetment in stabilizing the banks of the Missouri River. Presents criteria for consideration when planning for the control of erosion on alluvial streams.

SENSIDONI, FRANCESCO.

1. Rilievi e determinazioni sul trasporto solido del Fiume Reno a Malalbergo (Gagings and measurements of the suspended load of the River Reno at Malalbergo). *Ann. dei Lav. Pubblici*, no. 1, pp. 15-31, illus., Jan. 1938. In Italian. Translation on file at the U. S. Soil Conservation Service, Washington, D. C.

Deals with investigations on suspended load by the Hydrographic Section of Bologna on the River Reno. Gives methods, equipment, and data of a first group of measurements. Includes some granulometric analyses. Treats of the development of the computation of a measurement of the suspended load.

SERGAEV, M. S.

1. Ochestka zaeleynikh vodokhraheleshch (Cleaning of silted reservoirs). Sci. Res. Inst. Hydrotechnics, Trans., vol. 8, pp. 148-153, illus., 1932. In Russian. Translation on file at the U. S. Soil Conservation Service, Washington, D. C.

Considers the problem of the cleaning of silted reservoirs, giving method, cost, etc. Makes a few statements regarding the cleaning of silted reservoirs in Turkestan. Comments on the cleaning of reservoirs on the Murghab River.

SHALER, NATHANIEL SOUTHGAGE.

1. General account of the fresh-water morasses of the United States with a description of Dismal Swamp District. U. S. Geol. Survey, Ann. Rpt. (1888-89) 10, pt. 1, pp. 261-339, 1890.
Notes the character of the various fresh-water swamps in the United States. Describes the condition of all delta accumulations and considers, in greater detail, the phenomena exhibited by the Mississippi Delta.
2. The origin and nature of soils. U. S. Geol. Survey, Ann. Rpt. (1890-91) 12, pt. 1, pp. 213-345, illus., 1892.
Discusses the origin and nature of soils. Includes 18 pages tracing in some detail the geologic history of detrital deposition on alluvial plains. Discusses factors influencing the conditions of geologic land surface reduction.
3. The geological history of harbors. U. S. Geol. Survey, Ann. Rpt. (1891-92) 13, pt. 2, pp. 93-209, illus., 1893.

A report dealing with the geological history of harbors, their nature and origin, and their relation to the development of civilization. Includes discussion on delta harbors and considers the disadvantages inherent in this type, due to conditions of sediment transportation and deposition by streams, silting at the mouths of streams, and changes in channel which occur in delta districts. Notes method of improvement of river mouths by means of jetties.

SHAMOV, G. I.

1. Analiz sushchestvuiuschchikh zavisimostei mezhdv dvizheniem donnykh nanosov i elementami vodnogo potoka (Analysis of existing relations between bed-load movement and water flow). Sci. Res. Inst. Hydrotechnics, Trans., vol. 9, pp. 193-226, 1933. In Russian with a half-page abstract in English. Translation on file at the U. S. Soil Conservation Service, Washington, D. C., and the Institute of Hydraulic Research, University of Iowa, Iowa City, Iowa.
Analyzes equations ordinarily used for the determination of bottom silt flow, including those based on Du Boys' theory, and shows that none of these can be recognized as satisfactory. Discusses the problem of bottom silt flow and the various needs for a better understanding. Comments on various factors which affect the problem.
2. Brief information regarding the results of laboratory tests of silt samplers. Sci. Res. Inst. Hydrotechnics, Trans., vol. 16, pp. 218-220, illus., 1935. In Russian. Translation on file at the U. S. Soil Conservation Service, Washington, D. C., and the University of California, Berkeley, Calif.
Discusses the results of laboratory tests on various types of silt samplers. Tests are made on the cylindrical silt sampler (type of Tait-Binkley), silt samplers of Losievsky and Polyakov, and the silt sampler of the S. R. I. H. Various conclusions are given as a result of these tests.
3. Investigations of morphological types of formation of cross bars and of flood-plain deposits of the Volga River. Sci. Res. Inst. Hydrotechnics, Trans., vol. 16, pp. 201-208, illus., 1935. In Russian with an abstract in English. Translation on file at the U. S. Soil Conservation Service, Washington, D. C., and the University of California, Berkeley, Calif.
Deals with the physical characteristics of cross-bar and flood-plain deposits of the Volga River, U. S. S. R. Causes of bar formation are noted.

SHANNON, CHARLES W.

1. The sand area of Indiana. Ind. Acad. Sci. Proc., pp. 197-210, illus., 1911.

Gives a detailed description of the sand dune area of northern Indiana. Includes two paragraphs noting the occurrence of stream and valley deposits along the Ohio River and the White River and its tributaries.

SHAPOVALOV, LEO.

1. Experiments in hatching steelhead eggs in gravel. Calif. Fish and Game, vol. 23, no. 3, pp. 208-214, July 1937.

Presents results of experiments conducted in 1936 at Big Creek State Fish Hatchery, Calif., to determine the optimum conditions for the hatching of steelhead trout eggs in gravel beds, and for the survival of hatched fry. Briefly notes effect of silting caused by flood.

SHARMA, K. R.

1. Remodelling of Mithalak distributary. Punjab Engin. Cong., Minutes of Proc., vol. 20, pp. 77-106, illus., 1932.

Presents engineering details of the remodelling of the Mithalak distributary, Northern Branch, Lower Jhelum Canal, India, to obtain non-silting conditions. History of remodelling of the channel and the head regulator given. The condition of the channel before remodelling (1928), the silting problem, channel contraction works; and berm protection works, results of contraction of the Mithalak distributary, improvements in design of head regulator, and behavior of channel after remodelling discussed.

2. Effect of silt conduction by outlets on the regime of a channel. I. Indian Engin., vol. 92, pp. 315-316, Oct. 15, 1932.

Describes the role of outlets in altering the proportion of silt charge in the supply of a channel with particular consideration on the effect of silt conduction by outlets upon the regime of a channel. Observations were made on variation of silt charge carried in supply of the Lower Jhelum Canal, on conditions of silting and scouring and on distribution of silt in channel cross-section. Mathematics of alteration on silt charge and its grade by outlets of various silt conductive powers in a reach of a distributary, and procedure for design of the hydraulic section for channels are given.

3. Effect of silt conduction by outlets on the regime of a channel. II. Indian Engin., vol. 92, pp. 335-336, 356-357, Oct. 22-29, 1932.

Considers mathematically the effect of outlets in altering the proportion of silt charge in the supply of a channel, also the effect of outlets on the grade of silt transported.

4. Effect of silt conduction by outlets on the regime of a channel. III. Indian Engin., vol. 92, pp. 374-376, Nov. 5, 1932.

Presents examples illustrating the use of formula (developed in Indian Engin., vol. 92, pp. 315-316, 335-336, 346-357, Oct. 1932) concerning the effect of silt conductive power of outlets on the regime of a channel.

5. Silt conduction by irrigation outlets. Punjab Engin. Cong., Minutes of Proc. (1933), vol. 21, pp. 229-253, illus., 1934.

Describes and presents results of experiments conducted to investigate the possibility of improving the silt conductive power of various irrigation outlets in the Punjab.

6. A silt selective distributary head regulator. Punjab Engin. Cong., Minutes of Proc., vol. 24, pp. 29-471, illus., 1936.

Describes experiments on distributary head regulators to determine the efficiency of the various devices in silt exclusion. Describes design and presents results of observations on the efficiency as a silt excluder of a silt selective head regulator.

7. Design of irrigation channels. Inst. Engin. Calcutta, Jour., vol. 16, pp. 83-131, illus., Aug. 1936.

A paper in which the writer attempts to show how the factors of varied silt conduction by off-taking outlets, absorption, and silt attrition affect the design of irrigation channels so that no theory neglecting these factors would be perfect in its application. Presents a modification of Kennedy's theory of design of irrigation channels so that the foregoing mentioned factors are allowed for in their design.

8. Automatic silt extractors without loss of water. Indian Engin., vol. 103, no. 1, pp. 17-18, illus., Jan. 1938.

Gives design of silt extractors or ejectors to remove silt from the bed or irrigation canals. Describes improved types of ejectors constructed on Upper Jhelum Canal where the discharge is controlled by sluice valves and at Chak-Sakandar. A new design for use at Mancher distributary, Lower Chenak Canal is described. This device contains gates which open when weight of silt is great enough and close automatically preventing waste of water. Principles of design discussed and sketch of design is included.

SHARPE, C. F. STEWART. See also Thorntwaite, C. W., 1.

1. "Brushing out" the banks of streams. Soil Conserv., vol. 2, no. 10, pp. 221-224, illus., Apr. 1937.

Discusses the effects of local clearing of vegetation from the banks of streams on increased downcutting of channel, bank erosion, shoaling of streams with sand and silt, bottom land stream erosion, increased floods, and deposition of sand and silt in deltas, in bars, in reservoirs and in lakes. Cites case exemplifying these effects on a small stream in eastern part of Spartanburg County, S. C.

2. Landslides and related phenomena. 137 pp., illus. New York, Columbia Univ. Press, 1938.

Reviews the state of knowledge of and discusses all major types of mass movement. Presents a classification based on field study. Considers such subjects as types of mass movement, slow flowage, rapid flowage, landslides, subsidence, and significance of mass movement. Describes mud flows giving references to various works concerned with the study of the subject and discusses various types of mud flow. Treats also debris-avalanche and causes of rapid flowage. Includes a selected bibliography of 275 titles dealing with this subject.

3. Geomorphic aspects of normal and accelerated erosion. Amer. Geophys. Union, Trans., vol. 22, pt. 2, pp. 236-240, Aug. 1941.

Discusses the problem of "normal erosion" and "accelerated erosion." Notes changes in erosion due to man's use of the land. Considers recent work in the geomorphology of accelerated erosion, and treats basic research on the geomorphic background of soil development and accelerated erosion in the Piedmont.

Discussion: JAY A. BONSTEEL, pp. 250-253, makes various comments on Dr. Sharpe's article concerned with various aspects of "normal" and "accelerated" erosion. E. G. ZIES, p. 253, deals with accelerated erosion in volcanic areas. C. R. HURSH, pp. 253-254, considers geomorphic aspects of normal and accelerated erosion in the high-rainfall areas of the Appalachian Mountains. GEORGE B. CRESSEY, p. 254, comments briefly on normal and accelerated erosion. PETER E. WOLFE, pp. 254-255, makes comments on subsequent topography as an expression of structures, lithology, and soil. ROBERT T. KNAPP, pp. 255-256, deals with a concept of the mechanics of the erosion-cycle. Notes the cycle is made up of three parts: entrainment, transportation, and deposition. Gives a diagram which is a preliminary classification and subdivision of all forces acting in all three divisions of the erosion-cycle. MAURICE DONNELLY, p. 261, notes an inconsistency in Dr. Sharpe's paper dealing with soil creep. Proposes two new terms: "normerosion" for processes of land-sculpture which proceed undisturbed by man, and "accelerosion" for those processes induced or accelerated by man.

SHAW, ARTHUR M.

1. Silt and fertility [letter to editor]. Engin. News-Rec., vol. 104, no. 3, pp. 119-120, Jan. 16, 1930. Comments on an article entitled Agricultural Value of Nile Silt Held Fallacious (Taylor, E. M., 1) citing examples of the fertility of an occasionally silted sugar plantation on the Grijalva River in the State of Tabasco, Mexico, and the fertility of the lands overflowed by the Mississippi River in the lower delta regions.

The possibility is noted that weathering and gradual "ripening" of new silt-produced soil and its intimate mixture with older soils may be essential if the land is to produce crops year after year.

2. The Yellow River—a major flood menace in China. Engin. News-Rec., vol. 111, no. 9, pp. 261-265, illus., Aug. 31, 1933.

Describes the floods, delta, canals, levees, flood control, stream flow and silt load of the Chinese Yellow, Yantze, and Hwai Rivers.

Article notes the China Sea, Cushan Archipelago and the Grand Canal. Describes damage due to floods and scour of the river. Yellow River silt is fine loess, even finer than 200 mesh. It is quite uniform in size, shape and density, which explains in part the rapidity of channel changes in the delta areas. At one point of observation in 1919, channel scoured 500 per cent in 78 days and refilled with silt in 60 more days. Controversy exists as to extent of bed load but authorities agree on suspended load estimates. Desilting of Grand Canal after floods is performed by hand labor.

3. Load-recovery theory applied to Yellow River flood control. Engin. News-Rec., vol. 112, no. 26, pp. 839-840, June 28, 1934; also in Assoc. Chinese and Amer. Engin. Jour., vol. 16, no. 1, pp. 28-30, Jan./Feb. 1935.

Discusses the application to the Yellow River of E. W. Lane's proposal to apply the phenomenon of load recovery below dams for flood control purposes (Lane, E. W., 3). Notes the problem of providing a settling basin with sufficient capacity to retard the flow of a major flood and retain sufficient storage space for the silt of succeeding floods. Describes the characteristics of Yellow River silt, noting that samples of water have shown as much as 10 percent solids. Cites the need for hydraulic laboratory tests to study erosion, silt transportation, and deposition with reference to the load-recovery theory.

4. The control of floods. Assoc. Chinese and Amer. Engin. Jour., vol. 16, no. 2, pp. 81-86, Mar./Apr. 1935.

Describes means of and conditions favorable for flood control works on rivers in China. Notes briefly conditions of stream erosion and deposition unfavorable to flood control works on the lower Yangtze.

SHAW, EDMUND.

1. Washing—classifying sand—Part 4. Rock Prod., vol. 42, no. 8, pp. 65-66, Aug. 1939.

Discusses the laws governing the settling of sand in water and also formulas for computing the falling rate of velocities.

2. Washing—classifying sand—Part 5. Rock Prod., vol. 42, no. 9, pp. 35-36, Sept. 1939.

Describes methods and simple laboratory equipment required to compute falling rates of sands. Gives tables and curves developed from tests.

3. Fundamental principles of sand settling and devices for settling and classifying sand. 78 pp., illus. Chicago, Ill., Trade Press Pub. Corp., 1943. Discusses the general principles of settling; noting determination of falling rates, mathematics of settling, and conditions affecting rate of fall. Describes settlers and classifiers. Considers the principles of hindered settling.

SHAW, EUGENE WESLEY. See also Follett, W. W., 3; Trowbridge, A. C., 1.

1. The mud lumps at the mouth of the Mississippi. U. S. Geol. Survey, Prof. Paper 85, pp. 11-27, illus., 1914; [abstract], Wash. Acad. Sci., Jour., vol. 4, no. 9, pp. 221-222, May 4, 1914.

A paper dealing with the occurrence and formation of mud lumps at the mouth of the Mississippi River. Reports that the Mississippi is building land out into the sea at a rate of 300 ft. a yr. The delta is sinking at the rate of a tenth of a foot a year, as well as building upward and outward subsidence being greatest where the delta is growing most rapidly. The rate of progradation varies from season to season. Movements of sea water tend to spread and sort the sediment. Throughout the lower part

- SHAW, EUGENE WESLEY. - Continued
of the river's course it tends to build natural levees, and this tendency or some other factor has caused the delta to assume a bird-foot form. Mud lumps play an important part in arranging the material within the delta and perhaps in locating and permanently confining the river channels. The territory within a mile or two of each of the mouths of the Mississippi is characterized by large swellings or upheavals of tough bluish-gray clay, to which has been applied the name "mud lumps." Hilgard accounts for the formation of mud lumps by the flocculation of river-borne colloidal sediment by the salt of the sea, forming a layer of sludge; a more compact and granular layer is deposited on this sludge, giving rise to an unstable condition; where the compact layer is weakest the sludge is forced to the surface by the pressure of the sand and silt. Another hypothesis is that the mud lumps are produced by a gentle seaward flow of layers of semifluid clay under the land and the shallow water near the ends of the passes where this flow is opposed by the comparatively resistant parts of the forest beds. The tendency to flow is assumed to be due to pressure developed by constant additions of sediment. Results of mechanical and chemical analyses of sediment deposited near the mouth of the Mississippi are given.
2. Sedimentation along the Gulf Coast of the United States [abstract]. *Geol. Soc. Amer. Bul.*, vol. 27, no. 1, p. 71, Mar. 30, 1916.
Compares and contrasts individual processes and results of sedimentation along the west and Florida coasts of the Gulf of Mexico and at the mouth of the Mississippi River.
 3. Significance of sorting in sedimentary rocks. *Geol. Soc. Amer. Bul.*, vol. 28, pp. 925-932, Dec. 19, 1917.
Discusses the factors affecting the sorting of sediments, the fundamental cause of sorting, and the possibility of determining the origin of a sediment from a mechanical analysis.

SHAW, HARRY B.

1. Triadelphia Lake watershed. *Amer. Water Works Assoc. Jour.*, vol. 41, no. 10, pp. 928-931, Oct. 1949.

Describes a conservation program on the watershed of the Triadelphia Lake in order to reduce sedimentation. This lake is the principal source of water supply of the Washington Suburban Sanitary Dist.

SHAW, JOHN. See Dunn, E. J., Jr., 2.

SHELFORD, WILLIAM.

1. On river flowing into tideless seas, illustrated by the River Tiber. *Inst. Civ. Engin., Minutes of Proc.*, vol. 82, pp. 2-19, illus., 1885.
Uses the River Tiber to illustrate rivers flowing into tideless seas and points out differences from non-tidal rivers. Notes that this type of river has a large delta. Notes that the formula that the capability of a stream to move substances varies as the sixth power of its velocity, was first calculated by Wilfred Airy. Comments on the growth of the delta at the town of Ostia. Treats of methods of improvement of non-tidal rivers.
Discussion: WILFRED AIRY, pp. 25-26, explains his formula for the sixth power law, or the capability of a stream to move particles varies as the sixth power of its velocity. Points out that if the velocity of a current could be doubled, it would move particles of silt 64 times the weight that it did before. THE AUTHOR, pp. 47-50, gives data on Blackwell's experiments on the transporting power of water at varying velocities (1857). Includes a table from the report of the Minister of Agriculture, Industry, and Commerce, giving suspended-matter data, 1872-77, for the River Tiber.

SHELLSHEAR, WALTER.

1. On the removal of bars from the entrances to our rivers. *Roy. Soc. N. S. Wales, Jour. and Proc.*, vol. 18, pp. 25-35, illus., 1884.
A paper concerning the removal of bars from entrances to Australian rivers. Gives a general description of river entrances. Outlines theory

of the influence of ocean waves on bar formation at the mouth of rivers, stating that the combined action of flood tide and ocean waves is responsible for surcharging the lower stratum of water with sand which is carried by the tidal current and deposited in channels. Offers as a general principal the construction of breakwaters and the extension of these piers to sufficient depths. Rivers with which author has had experience did not deposit silt in the delta channels; they acted rather as excavators of the bars formed by the action of the ocean. By assisting this excavating power of the river, by constructing concrete piers and facine mattresses, many inlets that are closed to navigation may be made available.

SHENYI.

1. Purpose and scope of the Yellow River Project studies. *Studies on Yellow River Proj.*, Pub. 1, 11 pp., illus., June 1947.
Describes the purpose and scope of the Yellow River Project studies in China. Gives various features of the Yellow River and its drainage basin. Includes some data on silt runoff and silt content. Comments on the silt load of the Yellow River.

SHEPARD, FRANCIS P.

1. Daly's submarine canyon hypothesis. *Amer. Jour. Sci.*, vol. 33, pp. 369-379, May 1937.
Considers Daly's hypothesis which states that currents of heavy muddy water sliding down the continental slopes during the lowered sea level stages of the glacial epochs were the cause of submarine canyons. Notes that an analysis of conditions which might cause mud currents shows the improbability of such currents becoming erosive agents.

SHEPARD, WARD.

1. Forests and floods. *U. S. Dept. Agr. Cir.* 19, 24 pp., illus., Jan. 1928.
Presents pertinent data on the relation of forests to stream flow, erosion, and flood control. Gives the cumulative effects of deforestation in large rivers, and notes the effect of silt loads on reservoirs and engineering works. Recommends engineering works and well-kept forests as methods of flood control.

SHEPPARD, CHARLES A.

1. Some drainage projects in southwestern Illinois. *Ill. Soc. Engin. and Surveyors, Ann. Rpt.*, 28, pp. 22-26, 1913.
Discusses improvement of drainage conditions near Cahokia Creek and Wood River in southwestern Illinois. Silt deposition along the banks of the Cahokia Channel has destroyed good fields and pasture lands.

SHERMAN, E. A.

1. Erosion's conquest of our land. *Amer. Forests*, vol. 37, no. 4, pp. 195-199, illus., Apr. 1931.
This article stresses the seriousness of the erosion problem in the United States. Discusses the extent of damage to agricultural land by erosion caused by the Des Moines River which drains the richest farm land in America. Each year it carries into the Mississippi 518 tons of soil and soil materials for every 640 acres drained, an average of over 1600 lb. per acre.

SHERMAN, G. L. See Hubbell, D. S., 1.
SHERMAN, LEROY K. See Saville, T., 5.

SHERRILL, C. O.

1. Mobile Harbor, Alabama. *Prof. Mem.*, vol. 5, no. 17, pp. 1-27, illus., Jan./Feb. 1913.
Discusses past and present developments of Mobile Harbor, Ala. The effect of wind, tide, storm, and littoral current on the movement of sand is given. Notes that silt carried by rivers entering a harbor is largely deposited on bars at their mouths. Points out that a natural channel has been maintained by the outflow which has kept the outer bar scoured to a depth of 22 ft. without improvement. Discusses factors to be considered in determining the required depth of a wider channel and reviews the numerous plans suggested in providing for the commerce of Mobile Harbor. Notes cost of maintenance and enlargements.
2. The Port of New Orleans. *Prof. Mem.*, vol. 6, no. 1, pp. 1-47, illus., Jan./Feb. 1914.

A technical article relative to improvements of the Port of New Orleans. Presents an extensive recapitulation of bar formation theory on the Mississippi River as expounded by Humphreys and Abbot; also polemic of General Barnard on theory. Details are given of the surveys of 1837 and 1857, undertaken to determine the amount of silt transported through the delta passes of the Mississippi. It was noted that a total of 30,000,000 cu. yd. of silt are carried through annually, of which 10,000,000 cu. yd. are carried through the Southwest pass alone. Describes Port of New Orleans and gives details of facine mattress construction for bank revetment.

SHIELDS, A.

1. Anwendung der Aehnlichkeitsmechanik und der Turbulenzforschung auf die Geschiebepbewegung (Application of similarity principles and turbulence research to bed-load movement). Preuss. Versuchsanst. für Wasserbau u. Schiffbau, Berlin, Mitt., 1936. In German. Translation on file at the U. S. Soil Conservation Service, Washington, D. C., and the California Institute of Technology, Pasadena, Calif.

Deals with laboratory experiments to determine the effect of the weight and shape of grains upon the movement of water and bed load. Shows how shear and discharge can be computed for part of a perimeter. Develops an equation indicating that the coefficient of critical tractive force merely becomes a function of the Reynolds number of a grain. Considers the fundamentals of bed-load movement which are important from a practical point of view and presents an equation with which to estimate bed-load movement of almost any type of sand in either model or river. Describes experimental bed-load materials, apparatus, and method of procedure.

SHIELDS, W. H.

1. Sand bars on intermittent rivers. Roy. Soc. West. Austral. Jour., vol. 10, pp. 1-3, 1923-24. Describes a method for the scouring of sand bars on intermittent rivers in the southern part of western Australia.

SHIPMAN, JULIA M.

1. The New England flood. Jour. Geog., vol. 27, pp. 36-40, Jan. 1928. Describes the causes and damages incurred by the New England flood of 1927. Conditions of erosion and deposition of silt, particularly along the Lamoille and Winooski Rivers in Vermont are reported.
2. Local phases of the New England flood. Geog. Soc. Phila. Bul., vol. 26, no. 3, pp. 169-183, illus., July 1928. Describes causes, conditions, and effects of the flood of November, 1927, in western New England. Briefly notes damages due to silt deposition in rural and urban areas.

SHIRA, A. F. See Coker, R. E., 1.

SHOONMAKER, W. J. See Ruedemann, R., 1.

SHREVE, FORREST. See Bowman, I., 2.

SHRIKANT, RANBIR SINGH. See Munns, E. N., 5.

SHROCK, ROBERT R.

1. A classification of sedimentary rocks. Jour. Geol., vol. 56, no. 2, pp. 118-129, Mar. 1948. Proposes a simple field and laboratory classification of sedimentary rocks based on composition and texture; the primary divisions being determined by mode of origin of constituents.

SHULITS, SAMUEL. See also Einstein, H. A., 4; Griffith, W. M., 2; Kalinske, A. A., 2; Schoklitsch, A., 5; Vogel, H. D., 8-9; Whipple, W., Jr., 1.

1. Experience with bed degradation below dams on European rivers. Engin. News-Rec., vol. 112, no. 26, pp. 838-839, illus., June 28, 1934; also in Assoc. Chinese and Amer. Engin. Jour., vol. 16, no. 1, pp. 25-28, illus., Jan./Feb. 1935. Takes up briefly European experiences with degradation below dams. Includes figures which illustrate degradation of the bed of the Saalach River below the Reichenhall Reservoir in Bavaria, and aggradation of the Reichenhall Reservoir.
2. The Schoklitsch bed-load formula. Engineering, vol. 139, pp. 644-646, illus., June 21, 1935. A technical article discussing the Schoklitsch

bed-load formula which serves to compute that portion of the total solids load which is transported along the bed by tractive force of stream. Discusses rational basis of formula and notes that bed load, on quantity moved per unit time, is proportional to effective discharge, the difference between instantaneous and critical discharge. Formula is non-dimensional and not restricted to grain size. Gives experimental verification, using flume with sand between 1 mm. and 2 mm. of formula and determination of bed-load coefficient. Discusses new Schoklitsch formula for uniform-grain sands. Gives other rational verifications of formula, noting that of P. Du Boys which is based on assumption that bed material is composed of layers sliding over each other. This discussion is concluded in the following article.

3. The Schoklitsch bed-load formula. Engineering, vol. 139, p. 687, illus., June 28, 1935. Concludes preceding article and gives other laboratory verifications of the Schoklitsch bed-load formula; verifications in natural streams and application of new uniform-grain formula to sand mixtures. Author, in conclusion, notes the need for further comparative research to establish relation between bed-load coefficient in flume experiments and that obtained from actual measurements in natural streams.

4. (and Corfitzen, W. E.). First annual report (fifth progress report - 13th, 14th, and 15th sets) on retrogression observations below Boulder Dam. 7 pp., tables and graphs. Denver, Colo., U. S. Bur. Reclam., 1936.

Gives results of observations on retrogression, suspended load, and bed samples in the Colorado River. Gives resumé of the results of all the observations up to date.

5. Fluvial morphology in terms of slope, abrasion, and bed-load. Amer. Geophys. Union, Trans., vol. 17, pt. 2, pp. 440-444, illus., July 1936.

States briefly some of the qualitative observations and discusses in more detail several of the quantitative laws and their use relative to the science of the forms of river beds.

6. (and Corfitzen, W. E.). Bed-load transportation and the stable-channel problem. Amer. Geophys. Union, Trans., vol. 18, pt. 2, pp. 456-467, illus., July 1937.

Deals with studies relative to the problem of bed-load transportation in stable channels with particular reference to determinations of maximum particles-size which can be transported as bed load and which represent the size of material creating a stable channel. Summarizes, in connection with determination of size of bed-load material; (a) the bed-load formulas of Schoklitsch, Swiss Federal Institute of Technology, and U. S. Waterways Experiment Station, (b) tractive force formulas of Schoklitsch, Krey, Kramer, and U. S. Waterways Experiment Station, (c) data observed by Nuernberg Kulturan, Franzius, and Krueter on tractive forces required to move given particles-size, and (d) experience tables by Thrupp and Franzius on competent velocities. Discusses formulas presented and the limits of their applicability. Values computed by formulas showing maximum particle-size that can be transported at Imperial Dam site and at desilting works channels are given. References are included.

7. Solids transportation in mining and milling. Mines Mag., vol. 29, pp. 375-377, 401, illus., July 1939. Discusses the necessity of hydraulic laboratory research in connection with the design of launders in mine tailings disposal systems. Notes briefly, previous experimental investigations on solids transportation dealing with bed-load and tractive-force formulas and suspended-load calculations.

8. Rational equation of river-bed profile. Amer. Geophys. Union, Trans., vol. 22, pt. 3, pp. 622-630, illus., 1941.

Paper reviews certain principles which afford a rational derivation of the profile of river-beds and tests the results on several American rivers. The derivation of the equation of river-bed profile is presented. The Mississippi,

Ohio, and Colorado Rivers and an alluvial fan offer corroborative evidence of the velocity of the premise of the paper, that the wear-phenomena offer a rational approach to river-bed-profile morphology. Several remarks on applicability and limitations are given.

Discussion: W. W. RUBEY, pp. 630-631, comments on the exponential equation of stream-profiles. THE AUTHOR, p. 631, notes meaning of an empirical equation and a rational equation. Makes further comments on Mr. Rubey's discussion and the proposed slope-equation.

SIBERT, WILLIAM J.

1. (and others). The \$175,000,000 Boulder Dam project on the Colorado River. Engin. and Contract., vol. 68, no. 7, pp. 23-28, Jan. 1929.

D. W. Mead, R. Ridgeway, C. P. Berkey, and W. J. Mead, joint authors.

Report of the Advisory Board of Engineers and Geologists concerning the Boulder Dam project on the Colorado River. Writers discuss various features of proposed works, noting problems involved, and suggest means for their solution. They call attention to possible "blow-sand" silting of the proposed canal between the Colorado River and the Imperial Valley. The Board recommends that the canal be concrete lined through sand dune regions; and of sufficient slope to carry in-blown sand to a proper place for deposit and removal. Members of the Board state that Colorado waters are normally high in dissolved mineral-salt content and the waters impounded in the Black Canyon will partly overflow lands in the Virgin Valley having beds of soluble salts, but this problem is considered to be a temporary one since silt deposits will gradually seal off source of formation. They also point out that the heavy silt load of the Colorado River has enabled it to build the vast fertile deltaic lands of the Imperial Valley of California, and adjacent districts. Discusses the silt problem with reference to storage capacity of the reservoir and estimates the annual silt deposit in the reservoir to be approximately 137,000 acre-feet. Ultimately, with no upstream reservoir development, the reservoir would be filled with silt in 190 yr. Retention of silt in reservoir and settling of residual coarser matter would result in bed stabilization and silt elimination below the dam.

SIBERT, WILLIAM L. See Red Cross. U. S. American National Red Cross. Board of Engineers, 2.

SIDDONS, JOSEPH S. V. See West, F. D., 1.

SIDWELL, RAYMOND.

1. (and Cole, Clarence A.). Sedimentation of Colorado River in Runnels and Coleman Counties, Texas. Jour. Sedimentary Petrology, vol. 7, no. 3, pp. 104-107, illus., Dec. 1937.

A paper presenting results of observations on the deposits of the Colorado River of Texas in the Runnels and Coleman Counties, Tex. Describes briefly course of stream, geology of valley, tributaries, and vegetative conditions on watershed. Describes bed and suspended samples collected at Coffee, Curry Bend, and Stubbs. Conditions of erosion and the transportation and deposition of material by the stream is briefly described. Presents data on the character of observed sediments giving size, shape, extent of abrasion, and mineral content.

2. Types and sources of sediments deposited by the South Canadian River in New Mexico and Texas. Jour. Sedimentary Petrology, vol. 9, no. 1, pp. 36-41, illus., Apr. 1939.

Considers the variations of sediments deposited by the South Canadian River as related to rock outcrops from which tributaries receive their sediments. The number of tributaries, the character of stream bed, and the distance from sources also noted. Downstream gradation of heavy mineral deposits, and the mineral content of deposits in the New Mexico and Texas areas are given. Source of rock, relation of increase and decrease in abundance of heavy minerals to sediments transported to stream by tributaries, and the texture of sand deposits in stream channel are discussed.

3. Sediments transported by the Brazos River from High Plains, Texas. Jour. Sedimentary Petrology, vol. 10, no. 3, pp. 138-141, illus., Dec. 1940.

Deals with the sources of sediments transported by the Brazos River on the High Plains, Tex., and the physical characteristics and mineral content of deposits in the stream.

4. Sediments of Pecos River, New Mexico. Jour. Sedimentary Petrology, vol. 11, no. 2, pp. 80-84, illus., Aug. 1941.

Presents results of an investigation relative to the origin, characteristics, and abundance of heavy minerals in the sediments of the Pecos River, N. Mex.

SILCOX, F. A.

1. Forests and flood control. Amer. Assoc. Adv. Sci., Occas. Pub., 3, pp. 5-16, illus., Oct. 1936.

Discusses the importance of forest cover in watershed areas for the prevention of floods. Notes that Parrish Canyon flood of 1930, due to denudation and overgrazing in the Wasatch Mountain area, deposited in the valley, soil, rock, and erosional debris to a depth of from 1 to 7 ft. over orchard lands. States that the silting in irrigation canals of the Imperial Valley requires excessive annual expenditure for clearing purposes; that Elephant Butte Reservoir lost 9 percent of its capacity in 9 yr., and Zuni Reservoir lost 70 percent in 22 yr. due to silting; and that the reservoir and irrigation works of the Boise River, Idaho, are being heavily silted despite efforts to reduce accumulations.

2. (and Lowdermilk, W. C., and Cooke, M. L.). The scientific aspects of flood control. Amer. Assoc. Adv. Sci., Occas. Pub. 3, 47 pp., illus., Oct. 1936.

Three articles written by the authors and an introduction by W. S. Cooper which deal with aspects of flood control. Notes effects of forests and flood control. Comments on silt damage and debris movement, on agricultural land use and flood control, and on preventative measures. Gives the relations of engineering science to flood control.

SILLIMAN, BENJAMIN.

1. Sketch of the mineralogy of the town of New-Haven. Conn. Acad. Arts and Sci., Mem., vol. 1, pp. 83-96, Sept. 1, 1866.

Deals with the mineralogy of the town of New Haven, Conn. Briefly notes conditions of hill erosion and the transportation and deposition of erosional debris by streams in the vicinity of New Haven.

SIMAIKA, Y. M.

1. The suspended matter in the Nile. Egypt Min. Pub. Works, Phys. Dept. Paper 40, 70 pp., illus., 1940; [abstract], Engineer, vol. 171, no. 4443, pp. 168-169, Mar. 7, 1941.

A comprehensive report on silt investigations of the Nile River in relation to the Aswan Reservoir. Includes information on the amount and mechanical analyses of suspended solids at Aswan and Halfa, and discusses the volume-weight relationship of deposited sediment in Aswan Reservoir. Types of samplers and methods of measuring suspended load are described.

SIMMONS, H. B.

1. (and Fenwick, G. B., and Patterson, C. B.). Applicability of model studies to sediment problems in navigation channels. Fed. Inter-Agency Sedimentation Conf., Denver, 1947, Proc., pp. 225-231, illus., 1948.

Describes model studies used by the Corps of Engineers as an aid in solving problems concerned with a reduction in shoaling, or sedimentation in navigation channels. Use of hydraulic models at the U. S. Waterways Experiment Station is described. The types of models used and application to sedimentation problems are discussed. Three model investigations are described.

Discussion: D. T. HERBERT, pp. 231-232, points out various problems encountered in model studies. ROBERT T. KNAPP, pp. 232-234, gives three methods of attack employed at the Vicksburg Laboratory. Divides the laboratory techniques for studying hydraulic problems into a number of different classes.

SIMON, J. R.

1. The management of Wyoming's irrigation reservoirs. North Amer. Wild Life Conf., Trans., 3, pp. 433-439, 1938.

Notes the effect of silting and fluctuation of water level in storage reservoirs in Wyoming, on the quantity and type of plant, and fish life present. Specific examples of Guernsey and Pathfinder Reservoirs on North Platte River are described. The fish-stocking program, trial fishing experiments, and studies of foods present in water, on bed, and on shore line are discussed. It is concluded that silting and fluctuations of water surface result in scarcity of fish and fish food production. Two other reservoirs, Alcova and Seminole, on the same river, are under construction.

SIMON, P.

1. (and Haegelen, A.). Le Debit Solide des Cours d'Eau (Solids entrained in flowing water) [abstract]. Engineering, vol. 120, pp. 240-241, Aug. 1925. Abstract of a paper presented at the Third International Hydro-Electric Congress, Grenoble, July 4-8, 1925. Discusses the problem of the abrasive effect of silt on hydro-electric works. Describes existing conditions at various installations in France, and several appliances which would alleviate the problem.

SIMONDS, FREDERIC W.

1. Floating sand: an unusual mode of river transportation [abstract]. Tex. Acad. Sci., 1896, Trans., vol. 1, no. 5, pp. 115-116, 1897. Notes results of observations of floating sand under natural and laboratory conditions. Sand, observed by author, floating on surface of Llano River at Bessemer, Tex., Aug. 8, 1895, prompted laboratory investigation of the phenomenon. Floating sand may provide explanation of coarse sand being mixed with fine deposits.
2. 'Floating sand,' 'Floating stones.' Science n. s., vol. 11, no. 274, pp. 510-512, Mar. 30, 1900. A discussion dealing with the phenomena associated with floating sand and stones. Enumerates conclusions derived from observations on the Llano and the Connecticut Rivers, and experiments with various types of sands to ascertain conditions of sand flotation (Floating Sand: an Unusual Mode of River Transportation, by F. W. Simonds, Amer. Geol., January 1896). Various letters to writer and an article by G. E. Ladd (Amer. Geol., November 1898) substantiate writer's conclusion that floating sand is a common occurrence. Observations by Nordenskiold (Nature, Jan. 18, 1900), Carus-Wilson, and Evans (Nature, Feb. 1, 1900) on occurrences and conditions of sand flotation are briefly considered.

SIMONSON, R. W. See Troug, E., 1.

SIMPICH, FREDERICK.

1. Taming the outlaw Missouri River. Natl. Geog. Mag., vol. 88, no. 5, pp. 569-598, illus., Nov. 1945.

Describes the work of Government agencies concerned with the improvement of the Missouri River. Considers the flood problem, and shifting of the river. Considers the amount of silt carried past Omaha, Nebr., and notes briefly the silt problem.

SIMPSON, WM. F.

1. (and Cutler, J. S.). Land-use and flood-control. Amer. Geophys. Union, Trans., vol. 21, pt. 4, pp. 1141-1144, Sept. 1940. Deals with the control of soil erosion as a factor in soil and water conservation; the basis of which is proper land use. Describes objectives, general methods, and procedure of flood control surveys conducted in connection with land use planning by the U. S. Department of Agriculture. The present survey of Muskingum River watershed is cited as an example. Includes brief discussion on sedimentation studies on the Muskingum watershed, and on values of benefits derived by the reduction in sediment production through erosion control, and stream-bank protection measures.

SIMS, IVAN H. See Munns, E. N., 4.

SINCLAIR, SIR JOHN.

1. On flooding land. Amer. Farmer, vol. 10, no. 47, p. 369, Feb. 6, 1829.

Information relative to deposition of sediment on land by flooding. Describes briefly Loch Ken project of 240 acres in Scotland.

2. On warping land. Reprint from Code of Agriculture. Amer. Farmer, vol. 10, no. 48, p. 377, Feb. 13, 1829.

Brief discussion of the practice of warping in England, giving the origin of its practice, the nature of improvement, and the mode of carrying plan into effect. Discusses also river warping in Italy.

SINDOWSKI, F. K. HEINZ.

1. Results and problems of heavy mineral analysis in Germany. A review of sedimentary petrological papers 1936-1948. Jour. Sedimentary Petrology, vol. 19, no. 1, pp. 3-25, illus., tables, graphs, Apr. 1949.

Reviews the progress of research in sedimentary petrology, paying particular attention to heavy-mineral analysis. Considers the interpretation of sources of various assemblages, and treats studies of heavy minerals in modern river sands of Germany.

SISLER, J. D.

1. (and Fraser, T., and Ashmead, D. C.). Anthracite culm and silt. Pa. Geol. Survey, Ser. 4, Bul. M-12, 268 pp., illus., 1928.

Presents results of an investigation on the production and utilization of fine-sized anthracite in Pennsylvania. Includes discussion on silt, culm, and breaker discharge at collieries, and in streams. Methods of handling and storing silt are described, and the effect of storage method on the quality of silt is noted. Results of observations on silt accumulations in streams are given. Methods of recovering river and creek coal are described.

SKEMPTON, ALEX WESTLEY. See Cooling, L. F., 1-2; Glossop, R., 1.

SKERRETT, R. G.

1. Finishing the All-American Canal. Sci. Amer., vol. 157, no. 3, pp. 144-146, illus., Sept. 1937. Describes various features of the almost completed All-American Canal. States that Boulder and Parker Dams and the desilting plant of the Imperial Dam will remove from the waters of the Colorado all but 20 percent of the silt that has been entering Imperial Canal. Describes the desilting plant. Notes that, even now, the Colorado deposits on its delta an annual average amount of 170,000,000 cu. yd. of silt.

SKEY, WILLIAM.

1. Suspension of clay in water [letter to editor]. Sci. Amer. Sup., vol. 3, no. 53, p. 841, Jan. 6, 1877. Reprint of letter to editor from Chemical News commenting on the discovery (Durham, W., 1) relative to the effects of alkalies and their carbonates on the suspension of clay in pure water.

SKIDMORE, HERROL J.

1. Development of a stratified-suspension technique of size-frequency analysis. August 1948. Thesis (Ph. D.) — State University of Iowa; [abstract], Iowa Univ., Studies in Engin., Bul. 33, p. 59, 1949. Describes an experimental apparatus which was developed in order to obtain rapid size-frequency analysis based on stratification of a sediment sample. Points out that a comparison of results with those obtained by bottom-withdrawal analyses indicates the same relative precision of measurement. The time necessary for a test by the use of this apparatus is 6-8 min.

SLADE, J. J.

1. Sedimentation in quiescent and turbulent basins. Amer. Soc. Civ. Engin., Trans., vol. 102, pp. 289-305, illus., 1937; also in Amer. Soc. Civ. Engin., Proc., vol. 61, no. 10, pp. 1435-1451, illus., Dec. 1935.

Presents results of investigations to develop a workable theory on sedimentation in quiescent and turbulent basins, taking into consideration variations in the hydraulic value of elements of the sediment and variations in the degree of turbulence of the basins. Equations are given using constants of three classes, those representing characteristics of the sediment, those representing characteristics of the settling basin, and those depending on both character of sediment and degree of agitation of the fluid.

Discussion: THOMAS R. CAMP, pp. 306-314, criticizes Slade's reliance on the assumptions of A. Hazen in his *On Sedimentation* (Hazen, A., 2), which assumptions, according to some writers, are invalid in part. Considers the theories of Slade, Allen, Seddon, and others on basin sedimentation for the purposes of efficient settling basin design. HARRY H. HATCH, pp. 314-316, considers formulas for quantities remaining in suspension in settling tanks after definite time periods. HARRY H. MOSELEY, pp. 316-317, discussing the constants in Slade's equations, emphasizes the problem of stratification and flocculation of sediment. GEORGE J. SCHROEPFER, pp. 317-319, examines the applicability of Slade's equations to practical problems of sedimentation of sewage solids, noting characteristics of liquids and of solids. Treats design for settling tanks. THE AUTHOR, pp. 320-323, examines the limits of applicability of the equations in connection with basin sedimentation of homogeneous materials and coagulation. Possible practical applications and suggestions for experiments with sedimentation tanks are outlined.

2. The dynamics of sedimentation. Amer. Water Works. Assoc. Jour., vol. 29, no. 11, pp. 1780-1796, illus., Nov. 1937.

Presents a general formulation for the settling of solids through a turbulent viscous fluid based on established dynamical principles. Briefly summarizes previous paper by writer entitled *Sedimentation in Quiescent and Turbulent Basins* (Slade, J. J., 1) in which an analysis of the hydraulic behavior of suspended solids and an analysis of the dynamical properties of the basin are given. Included in appendix I and II are results of integration of pertinent differential equations, also tables for their numerical solution.

Discussion: L. V. CARPENTER, pp. 1796-1798, considers various problems involved in the design of purification plants, the design of basin, effect of physical characteristics of flocculent material on sedimentation (coagulation), and prediction of performance. Comments on Slade's use of the "distribution function" to account for variation in settling velocities of particles in unsettled suspension. Notes that method used by Slade to determine turbulent velocity is applicable only to granular material. GORDON M. FAIR, pp. 1798-1799, notes that there are two different functions of a coagulation basin and proposes their separation into two units: a true coagulation basin and a sedimentation tank. THE AUTHOR, pp. 1799-1802, comments on discussions by Carpenter and Fair, and presents an experimental demonstration of the validity of his theory on sedimentation in turbulent basins.

SLATER, C. S.

1. (and Carleton, E. A.). Variability of eroded material. Jour. Agr. Res., vol. 65, no. 4, pp. 209-219, illus., Aug. 15, 1942.

A study which analyzed a series of soil losses and the corresponding plot soil texturally and for organic-matter content. Eroded material was shown to be somewhat higher in organic-matter content than the eroding soil. Notes that all properties in which eroded material may differ from soil must be a direct result of the relative proportions of separates that are found in the material.

SLOSSER, J. W.

1. Compilation of rainfall and runoff from the watersheds of the Red Plains Conservation Experiment Station, Guthrie, Oklahoma, 1931-38. U. S. Soil Conserv. Serv., SCS-TP-32, 30 pp., illus., tables, graphs, June 1940.

Report is a compilation of hydrologic data on small watersheds at the Conservation Experiment Station, Guthrie, Okla. Contains data of soil loss in runoff water. A Ramser silt sampler and silt boxes were used to measure soil loss.

SLOTBOOM, G. See Schaank, E. M. H., 1.

SMETANA, J.

1. Appareil pour le jaugeage du debit solide entraine sur le fond du cours d'eau (A device for the measurement of the bed load of streams). Internatl. Assoc. Hydraulic Structures Res., 1st, pp. 93-94, 1937.

Describes a bed-load sampler which is equipped for the simultaneous measurement of velocity of flow. Notes that an electrical signal notifies the operator when the device contacts the stream bed. After filling, the operation of exit and entrance valves is automatic.

SMITH, CHARLES M. See Gooden, E. L., 1; Goodhue, L. D., 1.

SMITH, D. T.

1. The gathering of the waters; or the evolution of seas and rivers. South. Bivouac, May 1887, pp. 743-751, illus.

Comments on the formation of the sea and the genesis of rivers. Discusses deposition of bed material and erosive force of stream. The author presents a theory of double spiral movement which he believes is the principle underlying the motion of all fluids. Notes the effect of his theory on sediment.

SMITH, E. GOODRICH.

1. Irrigation. U. S. Patent Off., Rpt. 1860, Agr. pp. 166-224, 1861

A paper on irrigation giving early history and methods used in different countries. Detailed descriptions of irrigation projects in Egypt, Persia, Syria, Peru, the Roman Empire, Italy, France, Germany, Belgium, India, England, Scotland, and Java are given. Considers the amount of water necessary for irrigation in relation to the seasons, use, and nature of soil. Describes types of irrigation under the following headings: bed-work, catchwork, subterranean, and warping. Discusses warping or use of muddy water for building up and fertilizing land. Includes description of methods used, their advantages and disadvantages, seasons for best results, production, and cost, etc. The chemical analysis of silt is given.

SMITH, EDWARD GERALD. See Stevens, J. C., 6.

SMITH, ERASTUS G.

1. The Mississippi River as the source of water supply for the inhabitants of the Mississippi Valley. New England Water Works Assoc. Jour., vol. 19, no. 2, pp. 215-231, June 1905.

Deals with the utilization of the Mississippi River for water supply purposes. The factors influencing the character of the Mississippi River waters are discussed. Considers the general appearance of the stream, nature of dissolved and suspended material, and the significance of the silt in the self-purification of the river water.

SMITH, EUGENE ALLEN.

1. Report on the geology of the Coastal Plain of Alabama. Ala. Geol. Survey, Spec. Rpt. 6, 758 pp., illus., 1894.

Report deals with the geology of the Coastal Plain of Alabama, Cretaceous and Post Tertiary formations, and with the phosphates and marls of Alabama. Includes brief discussion (pp. 30-33) on the effects of mud deposition caused by the Nita Crevasse (Mississippi River, Mar. 13, 1890) on aquatic life in the Mississippi Sound and in Lake Bourgne.

SMITH, FRANK R.

1. Maintenance of levees. Iowa Engin. Soc., Proc., 49, pp. 36-39, 1937.

Describes and comments on methods of ditch and levee maintenance based upon observations in Harrison, Monona, and Pottawattamie Counties, Iowa, and in Burt and Washington Counties, Nebr. Silt deposition in ditches as a cause of levee failure is briefly considered. Notes that erosion control practices to prevent accelerated runoff and to keep ditches free from silt would reduce ditch and levee maintenance costs.

SMITH, G. E. P. See also Kelly, W., 1; Stevens, J. C., 6.

1. An instance of river scouring at Tucson, Arizona. Engin. News, vol. 60, no. 6, p. 160, illus., Aug. 6, 1908.

An illustrated technical news item citing an instance of river scouring on Santa Cruz River

- at Tucson, Ariz. during flood of Jan. 17-18, 1908. Depth of scour was 4 ft. while apparent depth of river was 2.5 ft. Since flood waters of western rivers are muddy it is impossible to estimate depth from previous knowledge of river bed.
- The physiography of Arizona valleys and the occurrence of groundwater. *Ariz. Agr. Expt. Sta. Tech. Bul. 77*, pp. 45-91, illus., June 15, 1938. Includes brief discussion on modifications in the physiographic balance on Arizona streams and bottom lands by the enterprises of men.
 - The groundwater supply of the Eloy district in Pinal County, Arizona. *Ariz. Agr. Expt. Sta. Tech. Bul. 87*, pp. 1-42, illus., June 1, 1940. Presents various data on the groundwater supply of the Eloy district in Pinal County, Ariz. Includes brief discussion on the flood control problem in the district, noting that "...where the Santa Cruz channel terminates, the aggradation in recent years has been so rapid that mesquite trees which were probably 10 ft. in height are now buried except for 2 or 3 ft. of the tree tops."
- SMITH, G. P.**
- Construction and maintenance of open ditches. *Iowa Engin. Soc., Proc.*, 24, pp. 89-93, 1912. A report dealing with the proper design, construction, and subsequent maintenance of open ditches in Iowa in order to minimize siltage conditions. Results of investigations relative to costs and methods of cleaning silt from open drainage ditches are briefly described.
 - Cost and methods of cleaning and drainage ditches. *Iowa State Drain. Assoc., Proc.*, 8, pp. 80-81, 1912. Address presenting results of an investigation relative to the costs and methods of removing silt from open drainage ditches in Iowa.
- SMITH, GEORGE.**
- (and Crozer, John P., and Painter, Winshall). The flood of 1843. *Del. Co. Inst. Sci., Proc.*, vol. 6, no. 2, pp. 54-86, illus., Jan. 1911. Describes damages and casualties caused by flood of August 1843, in Delaware County, Pa. Discusses the denuding and transporting power of the flood, and describes conditions of erosion and deposition in the county.
- SMITH, H. T. U.**
- Notes on historic changes in stream courses of western Kansas, with a plea for additional data. *Kans. Acad. Sci., Trans.*, vol. 43, pp. 299-300, 1940. Discusses the problems involved in studies dealing with changes in stream courses in western Kansas, noting the necessity for further study of the problem.
 - Geologic studies in southwestern Kansas. *Kans. Univ. Bul. 34*, 212 pp., illus., Sept. 15, 1940. This bulletin describes the topography, climate, stratigraphy, structural geology, physiography, and economic resources of Kansas. Includes information on the drainage history of streams in Kansas, and on river terraces in the Arkansas and Cimarron Valleys. Historic changes in stream channels of the Arkansas and Cimarron Rivers are noted.
- SMITH, J. FRED.** See Stetson, H. C., 1.
- SMITH, JOSEPH C.**
- (and Fry, William H.). The composition of sediments from the Potomac and Shenandoah Rivers. *Jour. Indus. and Engin. Chem.*, vol. 5, no. 12, pp. 1009-1011, Dec. 1913. Presents results of mineralogical and chemical analyses of sediments from the Potomac River at Cumberland, Md., the Shenandoah River at Riverton, Va., and at Harper's Ferry, where the two rivers join. The investigation was undertaken with a view to using the results in a study of soil erosion.
- SMITH, LLOYD B.**
- Erosion of stream banks. *Kans. Engin. Soc., Proc.*, 21, pp. 72-80, illus., 1929. Deals with the erosion of the banks of streams in alluvial or sandy soil, and with the problem of stream bank stabilization. Conditions of stream bank erosion and the effects of stream currents in the transportation, distribution and deposition of the solid material eroded from the banks of streams are discussed. It has been determined that a sloping or stepped bank is necessary for adequate bank protection. Principles to be considered in the design and location of permeable jetties are briefly discussed.
- 2. Why the Mississippi meanders [letter to editor].** *Engin. News-Rec.*, vol. 103, no. 23, p. 899, Dec. 5, 1929. Comments on an article (Claxton, P., 7) on the cause of stream meandering, noting particularly conditions near Island 26 in the Mississippi River below Ashport. It is stated that water tends to flow in straight lines unless deflected by force and that this fact accounts for meandering.
- SMITH, OSGOOD R.** See also Sumner, F. H., 2.
- Placer mining silt and its relation to salmon and trout on the Pacific Coast. *Amer. Fisheries Soc. Trans.*, (1939) 69, pp. 225-230, 1940. Deals with the effect of placer mining silt on salmon and trout on the Pacific Coast. Discusses the effect that silt may have on migrating adult fish, on the selection of spawning places, and on the survival of fish flood. Concludes that silt is harmful to salmon and trout if it is heavy enough to form a layer on the stream bottom, or if it persists during periods between floods.
- SMITH, T. R.**
- Scouring silt from canals. *Reclam. Rec.*, vol. 11, no. 8, p. 379, illus., Aug. 1920. Discusses the methods developed for removing sand from lateral channels of the Mapleton irrigation district, and of the Strawberry Valley project, in Utah. A frame is placed in the canal and loaded with rock until it rests on the bottom and is kept in position by stay lines to the banks, usually held by a man on either bank. Water flowing under frame scours silt and keeps it moving downstream ahead of the frame which, in turn, is moved downstream.
- SMITH, WALTER D.**
- A suggested plan for developing the lower Colorado River. *Engin. News*, vol. 72, no. 17, pp. 824-825, illus., Oct. 22, 1914. Discusses the importance of the project for developing lower Colorado River, the proposed plans concerning jurisdiction and administration, the engineering problems, and the methods of flood control. States that forcing the river into its old channel, without a satisfactory settling area, when load of silt each year amounts to 75 sq. miles, 1 ft. deep, will be expensive and insecure. Plan, given in detail to put troublesome part of silt in Salton Basin by means of sluices, so that old Alamo channel will scour deep enough to carry flood waters without using levees, is described.
- SMITH, WARREN D.**
- The geology of Luzon, P. I. *Jour. Geol.*, vol. 21, no. 1, pp. 29-61, illus., Jan./Feb. 1913. Presents detailed data on the physiography and geology of the Island of Luzon, P. I. Describes streams of the Island, noting difficulty involved in maintaining an open channel over bars at the mouth of the Cagayan River. The washing along of boulders by the Agno River, flood damages of the Bued River, conditions of stream erosion and deposition, and soil enriching value of finer material deposited on coastal plain are noted.
- SMITH, WILSON FITCH.**
- The influence of reservoir bottoms on stored water. *Engin. News*, vol. 72, no. 27, pp. 1289-1292, illus., Dec. 31, 1914. Describes the influence of reservoir bottoms on stored water in Kensico, Williamsbridge, Jerome Park, and Central Park Reservoirs, N. Y. Notes the accumulation of silt averages 6 in. in Kensico Reservoir after 24 yr. service. Average organic matter in silt amounts to 12.7 percent, while that in original soil of reservoir is 8.5 percent.
- SMYSER, RUDOLPH E., JR.**
- Development of structures on the Missouri. *Military Engin.*, vol. 22, no. 121, pp. 68-70, illus., Jan./Feb. 1930. Describes the development and use of the more important forms of structures to prevent bank erosion and to induce deposits on the Missouri

River. Types of structures considered include: floating, curtain, frame dikes, concrete piles, clump dikes and current retards, abatis, bank heads, and various types of revetment.

SMYTH, B. B.

1. The age of Kansas. *Kans. Acad. Sci., Trans.*, vol. 9, pp. 129-136, 1883-84.

Presents data on estimated rates of geologic erosion and deposition in Kansas. Includes brief discussion on the action of water as an agent of degradation. Estimates rate of land surface reduction in Kansas based upon observations of the solids loads of the Arkansas and Kaw Rivers.

SMYTH, HARRY DE W. See Tolman, R. C., 2.

SNOW, J. P. See Chittenden, H. M., 1.

SNYDER, JOHN E. See Nicholson, J. H., 2.

SOBOLEV, S. S.

1. Gully erosion on the territory of the European part of the U. S. S. R. *Pedology*, no. 2, 1938. In Russian. Translation on file at the U. S. Soil Conservation Service, Washington, D. C.

Discusses gully erosion in the European part of the U. S. S. R. Notes the composing of a map of the density of the gully-ravine net which makes it possible to compare the degrees of erosion in separate regions of the territory. Considers the distribution of gully erosion and the types of gully erosion dismemberment of the plains in the area. Considers the classification of types of erosion branching according to depth and character of branching of the watersheds, and of the gully-ravine systems. Attempts to study the peculiarities of erosion forms which result from different degrees of denudation of different strata in the region.

SOIL CONSERVATION SERVICE. See U. S. Soil Conservation Service.

SOIL EROSION SERVICE. See U. S. Soil Erosion Service.

SONDEREGGER, A. L. See also Allison, J. C., 3; Witzig, B. J., 1.

1. Physiography of water-sheds and channels, and analysis of stream action of southern California Rivers, with reference to the problems of flood control. *Amer. Soc. Civ. Engin., Trans.*, vol. 83, pp. 1111-1134, illus., 1919-20.

Discusses the physiography of watersheds and channels and gives an analysis of the action of streams of southern California with reference to flood control problems. Describes general and characteristic physical features, and the geology of southern California. The topics discussed include fundamental laws governing stream flow in a natural channel crossing easily erodible alluvial deposits; the relationship between stream slope and velocity and power to hold material in suspension; characteristics of the transportation and deposition of debris in larger rivers, with a description of stream action in mountain section, debris cone, valley section, and delta; and the characteristics of individual sections. The problem of flood control is said to involve prevention of erosion and movement of detrital matter. Requirements for effective flood control are considered.

Discussion: CHARLES A. POHL, pp. 1135-1137, notes Sonderegger's reference to observation by G. O. Newman, 1892, on the movement of Santa Ana River bed deposits to a depth of 15 ft. Gives observations by J. B. Eads on the extent of bed scour in the Mississippi River at St. Louis, and data taken from a Report by a Special Board of Engineers on Survey of Mississippi River (Document No. 50, 61st Congress, 1st Session) on extent of bed and bank erosion, and probable filling of pools above proposed dam resulting in necessity for dredging in the Mississippi River. Notes effect of Hales Bar Dam, Tennessee River, near Chattanooga on rise in river bed above dam.

FRANCIS H. WRIGHT, pp. 1137-1140, describes conditions of erosion and deposition by streams as affected by stream gradient noting conditions on the Mississippi River and on debris cone sections of southern California streams. Examines the utility of proposed stor-

age reservoirs on debris cones and along lower Mississippi. Presents data on extent of bank erosion and subsequent deposition along Mississippi River (Annual Report of Engineers, U. S. A. 1892 pt. 4, p. 3111) and describes movement of sand filling toward channel of the Mississippi during pile driving for a wharf construction. H. F. DUNHAM, pp. 1140-1143, describes geological character of the Susquehanna River; condition of seepage at sections of debris cones in southern California streams and the effective control of floods on debris cones; and slope characteristics of the Westfield River, Mass. FRED D. BOWLUS, pp. 1143-1146, presents data for Colorado River, May-August, 1914, on interdependence of water surface and stream-bed elevations and discharges. Discusses debris transportation, stream energetics, and size and character of transported material. Examines theories of silt transportation and deposition. THE AUTHOR, pp. 1147-1148, comments on discussions by Pohl and Wright with reference to scouring action of streams during freshets. Discusses the quantity and character of debris transported and deposited by southern California streams. Comments on discussion by Durham relative to seepage rates on sections of debris cones and gives data on gauging showing seepage in San Gabriel River and Santa Anita Creek.

2. Modifying the physiographical balance by conservation measures. *Amer. Soc. Civ. Engin., Trans.*, vol. 100, pp. 284-304, illus., 1935; also in *Amer. Soc. Civ. Engin., Proc.*, vol. 59, no. 10, pp. 1542-1563, illus., Dec. 1933.

Discusses the effects of conservation measures, by changes in watershed cover and stream regulation, on the physiographical balance of erosion and debris transportation and deposition by stream flow; and the effect of debris barriers on stability of stream bed and debris cone. Climatic factors affecting the physiographical equilibrium in nature are examined. Discusses the effect of watershed improvement by "super forestation" and "light deforestation" on debris production, runoff, and capacity of a stream to move its load. The effect of regulation by construction of an impounding reservoir on the regimen of a stream is considered with reference to altered conditions of erosion, debris transportation and deposition, and the effect of this regulation upon tributaries; the change in equilibrium on the Rio Grande, as a result of the construction of Elephant Butte Dam, is cited as an example. Notes that silt entering above Elephant Butte Dam amounts to 1.6 percent of the flow, by volume, the average annual silt burden being 20,000 acre-feet. Conditions of scour and fill below the dam are described. Discusses, in connection with the stabilization of stream courses on the debris cone sections in the arid Southwest, stream action on the cone and effectiveness of debris barriers, noting those on the Santa Ana and San Gabriel Rivers in southern California. In connection with the rate of debris production in mountain watershed, presents data relative to silt deposits in Buckhorn, Castlewood, Elephant Butte, Roosevelt, White Rock, Zuni, Lake Wichita, Lake Penick, McMillan, and Worth Reservoirs.

Discussion: H. H. CHAPMAN, pp. 305-306, notes the effect of overgrazing in accelerating erosion and arroyo formation in the San Juan River basin. Quotes, in part, J. M. Patties' description of the Gila River in 1824. E. B. DEBLER, pp. 306-307, notes the need for careful research in forestation as a conservation measure, and stresses the necessity for permanent erosion checks (silt barriers). Takes exception to Sonderegger's conclusions with reference to scouring, silting, and channel rectification below Elephant Butte Dam, Rio Grande project. FRANK E. BONNER, pp. 307-315, presents results of observations on the silt load of typical streams in the various major basins in the United States. In connection with silt-load determinations, discusses the factors affecting variations in volume-weight

determinations of deposited silt, bed-load estimates, effectiveness of reservoirs in the determination of silt loads, noting that Lake Austin retains less than 1/4 of the average annual discharge of suspended silt in the Colorado River of Texas and Elephant Butte Reservoir retains approximately the entire average annual suspended load of the Rio Grande. Regional variations in rates of land-surface degradation are discussed, noting in particular the effect of hydraulic mining operations in several basins of the Sierra Nevada in California on the detrital load of streams. Watershed factors conducive to accelerated soil erosion and subsequent depletion of storage capacities of reservoirs are considered. Presents data comparing the rates of silting in typical reservoirs of the Southwest with rates on 20 main storage reservoirs in California; notes the necessity of proportioning reservoirs to their respective drainage basins in order to reduce rates of siltation. The estimated average annual land surface reduction for the various major drainage basins and for the United States is given. C. S. JARVIS, pp. 315-317, comments on data presented by Sonderegger relative to the extent of scour and fill in the Rio Grande channel below Elephant Butte Dam. W. P. ROWE, pp. 317-324, comments on Sonderegger's discussion relative to the effect of watershed improvements on debris production and runoff, noting conditions in the La Crescenta-Montrose area, southern California; on the effects of deposition of debris resulting from construction of debris barriers; on the influences of changing climatic conditions on the physiographical balance of streams in southern California; and on the effectiveness of Haines and Pickens Canyons debris barriers. J. C. STEVENS, pp. 324-326, challenges the theory that physiographical factors tend to produce a balance. GERARD H. MATTHES, pp. 326-328, considers the effects of reservoir construction on the physiographic balance of a stream, noting conditions of channel deterioration by excessive bed scour immediately below a reservoir and loss of cross-sectional area in lower reaches. Means of minimizing alterations in equilibrium are noted. Calls attention to the factor of compaction of debris accumulations in streams and compares conditions of compaction of deposited material in streams of the East and the arid Southwest. Notes the necessity of maintaining the debris-carrying capacity in streams. J. B. LIPPINCOTT, pp. 328-335, notes the menace of temporary debris dams citing the effect on such structures of the New Year's Day storm (1934) in the Verdugo Creek drainage basin, near Los Angeles, Calif. Discusses the beneficial effect of forests in regulating flood and debris flows, presenting quantitative determinations of this effect by foresters in southern California. RHODES E. RULE, pp. 335-337, cites evidence that destructive floods are attributed to denudation by fire and overgrazing. Discusses the economic aspects of controlling flood and mud flows in southern California. Comments on Sonderegger's discussion relative to the effect of regulation upon the natural equilibrium of a stream. THE AUTHOR, pp. 337-346, comments upon several previous discussions pertaining to the importance of watershed cover and its effect on debris production and runoff, and the effect of rainfall on vegetal cover. Takes exception to Chapman's assertions relative to the recency of silt production in the Colorado River and its tributaries, and questions the statement that overgrazing is a major phenomenon affecting the physiographic balance of the West. Notes the value of Bonner's discussion relative to rates of debris production of typical streams, storage depletion by silting, and rates of land surface denudation. Design and effectiveness of debris barriers are discussed.

3. Remarks on water-spreading. Amer. Geophys. Union, Trans., vol. 17, pt. 2, pp. 474-476, July 1936.

Discusses the problems involved in the spreading of flood waters with particular reference to the effect of muddy water diverted from streams in flood-flow. Proposes use of spreading ditches as feasible solution for the diversion of muddy waters, provided velocities in ditches are non-scouring and non-silting, and bed load is excluded. A study of geology of watershed will aid in the determination of the character of deposited material. Results of operation of spreading ditches on Santa Ana Cone in southern California are described.

SOPP, C. W. See also Hoyt, W. G., 1.

1. Measurement of debris transported from burned areas. In Amer. Soc. Civ. Engin., Irrig. Div., Com. on Conserv. of Water, Rpt. on Prog., Conf. on Water Conserv., Los Angeles, Calif., Mar. 13-14, 1935, pp. 63-68, Dec. 1935.

Comments on the measurement of debris transported from burned areas. States the problems arising from such accelerated erosion, noting among them the silting of storage and diversion works and canals. Describes methods of debris transportation in suspension, in semi-suspension (saltation), and as bed load. Discusses succession of material transportation after denudation by fire, rate of erosion and transportation, and measurement of transported material by volume and by density. Describes the Tait-Binckley sampler, noting mode of operation and effectiveness. Data (bottle samples) on percent by volume of silt from burned drainage areas, and percent of drainage area burned are given. The studies lead to the conclusion that the power of a stream to transport objects varies with the sixth power of velocity. Gives a table showing siltation by transported debris from burned drainage areas of Gibraltar and Devils Gate Reservoirs, Calif. Gives data indicative of the deposition that has occurred in Pacoima Reservoir near San Fernando, Sawpit Reservoir near Monrovia, and San Dimas Dam near San Dimas. Notes investigations of the California Forest and Range Experiment Station in measuring debris eroded from sample plots, and in measuring transportation of debris by deposition in basins created by the Ambursen dams. Describes and compares means of measuring the amount of debris transported by streams.

Discussion: E. C. KENYON, JR., pp. 68-72, reports the stages of erosion and debris transportation of maximum debris content of a flood wave originating in a burned-over watershed. Includes tabulation of mechanical composition, apparent percentage volume of wet solids after 24 hr. settlement, and weight relation of dry to wet solids of samples taken during the rising and the falling stages of stream flow from burned areas in Haines and Dunsmuir Canyons during December 1934. Discusses the economic importance of a study of debris transportation phenomena.

SORZANO, JULIO F.

1. Water supply for the Lock Canal at Panama. Amer. Soc. Civ. Engin., Trans., vol. 67, pp. 61-90, June 1910.

Discusses the problem of water supply for the Lock Canal at Panama. Notes that the water supply as planned will be insufficient for the use of the U. S. Navy.

Discussion: THEODORE PASCHKE, pp. 106-108, considers the possible effect of sediment deposition in Gatun Reservoir upon conditions of percolation through the bottom and sides of the reservoir. THE AUTHOR, pp. 133-205, comments on discussion by T. Paschke relative to silting in Lake Gatun and its effect upon percolation in the reservoir. Brief data are given on the character of the new silt, the probable extent of silting, and distribution of silt in the reservoir to show that sediment accumulations will not prevent normal seepage and will not measurably effect percolation.

SOUTH AFRICA. DROUGHT INVESTIGATION COMMISSION.

1. Final report...October, 1923. 222 pp., illus. Cape-town, 1923.
Presents results of an investigation of problems arising from drought losses in the Union of South Africa. Includes discussion on irrigation and silting, the economic aspects of reservoir silting in South Africa, the detrimental action of silt on the storage capacity of reservoirs, and the necessity for study of the silt aspect of rivers. Gives data on silt content of some streams in South Africa, rates of silting in the Bongola Reservoir and in the two Bloemfontein reservoirs, and an estimate of total silt annually transported to the sea by streams of the Union of South Africa.
 2. The scope and practice of irrigation. So. Africa, Dept. Agr., Jour., vol. 11, no. 4, pp. 329-337, illus., Oct. 1925.
Deals with the various aspects of irrigation in the Union of South Africa. Notes briefly the problem of reservoir silting in connection with water storage for irrigation purposes.
 3. The ill-results of veld-burning and the value of trees. So. Africa, Dept. Agr., Jour., vol. 11, no. 4, pp. 391-395, Nov. 1925.
Notes that streams of the Union carried away some 187,000,000 tons of earth during the 1919-20 season. Describes effects of deforestation by burning in the mountain areas of the Union of South Africa; points out the value of afforestation for the prevention of soil erosion.
- SOUTHWOOD, H. B. See Dobbins, W. E., 1.
SPAULDING, CHARLES H. See Anderson, S. T., 1.
SPECHT, G. J.
1. The treatment of sediment-carrying mountain streams in Europe and its application to California. Engin. News, vol. 14, pp. 289-291, illus., Nov. 7, 1885.
Describes the application to California of European methods for the permanent improvement of sediment-carrying streams. Discusses the characteristics of torrential streams with reference to the origin of runoff and debris, stream classification and subdivisions, and action of torrential streams in the transportation and deposition of detritus. Describes the means of improving mountain streams as employed in France by reforestation at the source. Bank and bed protective measures and use of retention dams at headwaters to decrease the formation of detritus and to store accumulation at its source, improved drainage conditions, reforestation on steep slopes, and treatment of steep portions of the stream are discussed. Describes conditions of stream deterioration in California, noting in particular the effects of hydraulic mining. Notes that in 1879 sediment in the Sacramento River, due to natural wash, amounted to 4,900,000 cu. yd. and that hydraulic mining was responsible for 13,200,000 cu. yd. of wash.

SPENCER, J. E.

1. Turbulence in the Yangtse. Geog. Rev., vol. 25, no. 1, pp. 162-163, Jan. 1935.
Cites observations of turbulence and deposition in the Yangtse River, illustrating Leighly's principle of deposition in quiet reaches outside main lines of turbulence.

SPENCER, JOHN N. See Munns, E. N., 5.

SPERLING, WALTER.

1. Betrachtungen über die Geschiebebewegung in fließenden Wasser (Considerations concerning bed load in flowing water). Bautechnik, vol. 17, no. 47/48, pp. 598-601, Nov. 3, 1939. In German. Translation on file at the Engineer Department Research Centers, U. S. Waterways Experiment Station, Vicksburg, Miss.
An analysis of bed-load movement with particular emphasis upon the similarity between bed-load phenomena of rivers and the sea bottom. Treats the broad field of bed-load movement and supports the theory with practical observations.

SPIEKER, E. M.

1. Bituminous sandstone near Vernal, Utah. U. S. Geol. Survey Bul. 822-C, pp. 77-98, illus., 1931.

Deals with the chemical and mechanical analysis of bituminous sandstones near Vernal, Utah. An estimate was made of the amount of bituminous rock in the area. Notes the use of carbon disulphide baths in order to extract the bitumen.

SPIELMAN, A.

1. (and Brush, C. B.). The Hudson River tunnel. Amer. Soc. Civ. Engin., Trans., vol. 9, pp. 259-277, illus., 1880; also in Engin. News, vol. 7, pp. 265-267, illus., Aug. 7, 1880.

Describes the construction of the Hudson River tunnel. Material through which tunnel is built is a tenacious silt weighing 100 lb. per cu. ft. Effect of air under pressure caused silt to crack. Silt when exposed to running water dissolved and flowed readily with water. Notes compaction characteristics of silt in holding tunnel in position. Gives discussion relative to the characteristics of silt.

SPRECKLEY, J. A. See Griffith, W. M., 1.
SPRING, F. J. E.

1. The Kistna Bridge, East Coast Railway, India. Engineering, vol. 62, pp. 7-10, illus., July 3, 1896.
Describes various features of construction of bridge over Kistna River at Bezwada, India. Includes one paragraph noting that site of bridge is at a deltaic point and that fine silty clay which Kistna River carries in suspension, during flood time, amounts to 1/432 of its bulk.

SPRINGER, J. F.

1. Making the flood dam itself. Sci. Amer., vol. 125, no. 17, pp. 38-39, illus., Nov. 1921.

Describes a simple wire netting structure which gathers mud, boulders, and miscellaneous debris to form porous dams in torrential streams. Installations in Laurel Canyon and Riverside, Calif., are described.

SQUIRES, LOMBARD.

1. (and Squires, Walter, Jr.). The sedimentation of thin discs. Amer. Inst. Chem. Engin., Trans., (1937) vol. 33, pp. 1-11, tables and graphs, 1938.
States that vertical and horizontal orientation data of a disc during sedimentation can be correlated on a friction factor-Reynolds number plot. Evaluates the wall correction for sedimenting discs in the viscous range and points out that the sedimentation velocity of a thin disc is 50 percent greater when oriented vertically than when having a horizontal orientation. Large errors may be acquired when Stokes' law for spheres is used in calculating the particle size of thin discs from their sedimentation velocity.

SQUIRES, WALTER, JR. See Squires, L., 1.

STABLER, HERMAN. See also Dole, R. B., 2; Hoyt, W. G., 1; Lawson, L. M., 7; Stevens, J. C., 2.

1. Silt in the proposed reservoirs of the Ohio Basin. Engin. News, vol. 60, no. 24, pp. 649-651, Dec. 10, 1908.

Reports estimated rates of silting in reservoirs on various streams of the Ohio River drainage system, and presents tabulated data (M. O. Leighton, Engin. News, May 7, 1908). Notes that the proposed reservoir will retain 90 percent of its capacity for a duration of 835 yr. States that relationship between reservoir capacity and tributary drainage area is a controlling factor in reservoir silting. Points out that measurements of silt deposits at the diversion dam and the reservoir on Tuolumne River at La Grange, indicate that reservoir lost more than 50 percent of its capacity in 10 yr. as a result of silt deposited in a small storage reservoir. Offers a table of grouped data concerning suspended matter determinations, silt load of streams (based on 95 lb. of silt per cu. ft. of sediment), and time required to fill reservoirs of assumed capacities on different streams in the United States. Notes necessity for providing desilting works at reservoirs. Comments on accuracy of estimated rates of silting of proposed reservoirs, the effect silting may have on stream flow, the relationship between weight of suspended matter and volume of deposited material, suspended-load determinations, and method of calculation.

2. (and Parker, Horatio N.). The silt problem: Kaw River. Engin. News, vol. 63, no. 22, pp. 643-644, June 2, 1910.

Summarizes the study of suspended load in Kaw or Kansas River at Holliday, Kans. This study covers 72 periods of approximately 10 days each from 1900 to 1908. Comparison of discharge and relative amount of suspended matter shows that suspended matter generally varies directly with discharge. Maximum suspended matter in any flood occurs considerably in advance of maximum discharge, and suspended matter for a given stage is generally greater on a rising than a falling stage. Relative variation is much greater in suspended matter than in discharge. Tables are given.

3. Some stream waters of the western United States. U.S. Geol. Survey, Water-Supply Paper 274, 188 pp., 1911.

Report of a systematic study of various stream waters in western United States to determine the influence of salinity of water on vegetative growth and the relation between suspended loads of streams and silting of canals and reservoirs. Work started in 1905 and continued in 1906. Samples were collected for an extended period at 55 gaging stations on the following streams: Colorado, Green, Grand, Gunnison, Animas, Little Colorado, Gila, San Francisco, Salt, and Verde Rivers in the Colorado River basin; on Boise, Malheur, Payette, and Palous Rivers and Salmon Creek in Columbia River basin; on Carson, Truckee and Owens Rivers in Great basin; on Link River in Klamath River basin; on Milk, Yellowstone Bighorn, Shoshone and Belle Fourche Rivers in the Missouri River basin; on the Sapellow River in the Arkansas River basin; on the Salt Fork of the Red, North Fork of the Red; and Elm Fork Rivers and Turkey Creek in the Red River basin; on Rio Grande, Gallinas, and Hondo Rivers in the Rio Grande basin, on Sacramento Pit, Feather, and Yumba Rivers and Puta and Stony Creek in the Sacramento River basin; and on the Tuolumne River in the San Joaquin River basin. Discusses the method of sampling, methods of analysis, and accuracy of data. Results are given in tabular form showing date of sampling, partial analyses, gage heights, and rate of discharge of water and solids for individual stations.

4. Does desilting affect cutting power of stream [letter to editor]. Engin. News-Rec., vol. 95, no. 24, pp. 968-969, Dec. 10, 1925.

Letter to editor with reference to article, Effect of Rio Grande Storage on River Erosion and Deposition (Lawson, L. M., 7), on erosive powers of desilted waters leaving Elephant Butte Dam. Data presented in Lawson's paper are analyzed by Stabler to show erosion of 460 acre-feet per yr. for the 10-yr. period, 1915-25 for a distance of 100 miles below the dam. This degradation is 100 times greater than in the area tributary to the reservoir. Effect of river slope on relative amounts of degradation and aggradation are noted.

5. Rise and fall of the public domain. Civ. Engin., vol. 2, no. 9, pp. 541-545, Sept. 1932.

An account, giving the history, size, revenue, and maintenance costs of the public domain. Includes six paragraphs on the Colorado River basin, noting particularly southeastern Utah, northeastern Arizona, southwestern Colorado and northwestern New Mexico. Reports that the basin contributes 3000 tons of suspended matter per sq. mile of drainage area per yr. or a total of 70 percent of all the sediment that reaches the Grand Canyon. Notes the effect of torrential summer showers on the bare area producing "veritable river of flowing sand and mud." Cites example of such a storm observed on Hunter Creek Aug. 6, 1926, with an estimated volume of about 150 acre-feet of water and suspended load, estimated from bucket sample of 30 acre-feet. Notes impracticability of fostering vegetable growth to protect watershed.

STAFFORD, HARLOWE M.

1. General report of the Rio Grande joint investigation. U. S. Natl. Res. Com., Region. Planning, pt. 6, vol. 1, pp. 1-194, illus., Feb. 1938.

The investigation is concerned with the water problems of the upper Rio Grande above Fort

Quitman, Tex. It presents data on and results of a comprehensive investigation relative to the quality of waters in the basin.

STAIRMAND, C. J. See also Carey, W. F., 1.

1. (and Carey, W. F.). Apparatus for particle size analysis. Engineering, vol. 154, no. 3997, pp. 141-142; no. 3999, pp. 181-182, no. 4001, pp. 221-222; no. 4002, pp. 241-242, 1942; [abstracts], Bldg. Sci. Abs. (n. s.), vol. 16, no. 1, pp. 8-9, Jan. 1943; Concrete, vol. 51, no. 7, p. 204, July 1943.

Describes a photographic sedimentation apparatus developed in the laboratories of Imperial Chemical Industries, Ltd. The apparatus photographs the tracks of particles within the range of 2-100 microns as they fall in stagnant liquid under the attraction of gravity. By applying Stokes' law the particle size may be calculated and a grading curve obtained. Treats of various methods of particle size analysis and notes their usefulness. Points out that for particles which range in size from 0.3 to 10 microns the microscopical methods are most suitable, for the range of 2-100 microns the photographic methods are best, and for 10-80 microns elutriators are acceptable.

STALL, J. B. See also Brown, C. B., 30.

1. (and others). The silt problem at Spring Lake, Macomb, Ill. Ill. Dept. Registr. and Ed., State Water Survey Div., Rpt. Invest., no. 4, 87 pp., illus., tables and graphs, 1949.

L. C. Gottschalk, A. A. Klingebiel, E. L. Sauer, and E. E. De Turk, joint authors.

Cooperative investigation by the Illinois Water Survey Division, the Illinois Agricultural Experiment Station, and the U. S. Soil Conservation Service dealing with problems due to loss of soil from a watershed which caused a reduction of land to produce fiber and food, and reduced the capacity of a municipal reservoir used by Macomb, Ill. Gives sedimentation data acquired by a sedimentation survey in 1947. Notes that by 1953 the reservoir will be inadequate to furnish the needs of the city in case of a drought. Points out that 14.23 acre-feet of sediment are deposited in Spring Lake every year and the deposits in the lake represent an average annual loss of 47.93 cu. ft. or 1.44 tons of sediment per acre from the watershed. Gives data on chemical and physical properties of the sediment. Shows that the sediment in the lake has a potential value as fertilizer of \$21,900. Presents results of a conservation survey on the watershed. Estimates that a total protective program would reduce soil loss 80 percent. Includes data on land use and the conservation history of the watershed. Gives possible remedial measures for maintaining a water supply for Macomb.

STALLINGS, J. H.

1. Menace of soil erosion. Amer. Water Works Assoc., Jour., vol. 27, no. 4, pp. 513-519, Apr. 1935; [excerpts], Water Works Engin., vol. 88, no. 1, pp. 42, 45, Jan. 9, 1935.

Gives erosion rates from barren cultivated, and forested land, and its effect on the silting of reservoirs. Fertile soil equivalent to 1250 farms of 160 acres each are transported from the Mississippi River to the Gulf of Mexico annually. Eleven out of 13 reservoirs on upper Deep River silted to capacity in the last 40 to 50 yr.; one within 31 yr. Dam across the Colorado River at Austin, Tex. silted to 85 percent capacity in 20 yr. Elephant Butte Reservoir, which costs \$10,000,000, designed for a life of 233 yr. will be completely silted in 60 yr. City reservoirs of Spartanburg, S. C., High Point, N. C., and Greensboro, N. C., are losing capacity at rate of 2.14, 2.26, and 1 percent per annum respectively. Morgan Falls plant on Chattahoochee River was completely filled in 10 yr. Raleigh, N. C. municipal reservoir lost one-third capacity due to silting. Runoff experiments were carried on at Statesville, N. C., San Dimas, Calif., Tyler, Tex., and New Orleans, La. Silt load of runoff waters and the effect of forest fires on silt load are reported. Information on silting of Potocat Creek, Randolph County, N. C., due to accelerated erosion arising from removal of timber during mining operations is given.

STAMM, ALFRED J.

1. (and Svedberg, The.). The use of scattered light in the determination of the distribution of size of particles in emulsion. *Amer. Chem. Soc., Jour.*, vol. 47, no. 6, pp. 1582-1596, June 1925.

Discusses the use of scattered light in the determination of distribution of the size of particles. Describes apparatus and method used in the study which considers emulsions. Obtains mass-distribution curves which agree with those calculated from microscopic measurements.

STAMP, L. DUDLEY.

1. Recent coastal changes in south-eastern England—some economic aspects of coastal loss and gain. *Geog. Jour.*, vol. 93, no. 6, pp. 496-503, illus., June 1939.

Discusses loss of coastal land through steady eating away of land by a combination of sub-aerial and marine erosion and by sudden and catastrophic losses. Land gained is of three types: shingle banks, sand-hills and dunes, and alluvial flats. One-third of the first-class land of England lies in Fenland, of which extensive areas represent reclamations since Roman times. Includes map of areas adjacent to the Wash reclaimed since 1858.

STANLEY, J. W. See also Witzig, B. J., 1.

1. Sixth annual report on retrogression observation, salinity studies, and suspended load investigations—Colorado River basin. 16 pp., tables and graphs. Denver, Colo., U. S. Bur. Reclam., 1941. Deals with retrogression observations below Boulder and Parker Dams on the Colorado River. Gives data on suspended-load studies on the Colorado River, Yuma main canal, and Alamo Canal. Data on salinity studies on the Colorado River are also included.
2. Seventh annual report on retrogression observations, salinity studies, and suspended load investigations—Colorado River basin. 16 pp., illus. Denver, Colo., U. S. Bur. Reclam., 1942. Outlines the extent of observations, observation procedures, and results of retrogression studies below Boulder Dam and Parker Dam; and suspended-load studies on the Colorado River and Yuma, Alamo and All-American Canals. Describes aggradation above the Imperial Dam, and salinity studies of water in the Colorado River and Lake Mead.
3. Eighth annual report on retrogression observations, salinity studies, and suspended load investigations—Colorado River basin. 19 pp., tables and graphs. Denver, Colo., U. S. Bur. Reclam., 1943. Presents salinity studies and the results of retrogressions and aggradations in the Colorado River basin. Gives data on observations made during 1942, and a summary of information from earlier years.
4. Ninth annual report on retrogression observations, salinity studies, and suspended load investigations—Colorado River basin. 23 pp., tables and graphs. Denver, Colo., U. S. Bur. Reclam., 1944. Presents results of retrogression and aggradation observations, suspended load investigations, and salinity studies on the Colorado River. Data obtained during 1943 are included as well as data from previous reports.
5. Effect of dams on channel regimen. *Fed. Inter-Agency Sedimentation Conf.*, Denver, 1947, *Proc.*, pp. 163-166, illus., 1948.

Describes the effects of dam construction on channel regimen of streams as shown by measurements on the Colorado River after construction of Hoover Dam. Discusses the applicability of Colorado River measurements to other streams. Reviews measurements on the Colorado River.

Discussion: D. C. BONDURANT, pp. 166-167, comments on tendency of a degrading channel to meander below a reservoir. Notes seriousness of aggradation and use of reservoirs to promote degradation on the Rio Grande. THE AUTHOR, p. 167, notes need for study of the effect of dissolved solids on sediment deposits. R. H. RUPKEY, p. 167, thinks that there is no great change in the material as the bed was scoured deeper at Headgate Rock Dam, below Parker Dam.

STARLING, WILLIAM. See also Coppee, H. St. L., 1; Haupt, L. M., 3; Hooker, E. H., 1; Ockerson, J. A., 1.

1. The improving of the Mississippi River. *Amer. Soc. Civ. Engin., Trans.*, vol. 20, pp. 85-108, illus., Mar. 1889.

Describes character of the river, its banks, and bottom; conditions conducive to overflow; conditions on flood plain; effect of velocity at bends on bank caving; effect of velocity on transportation of sediment; and conditions favorable to deposition resulting in shoaling. Discusses action of the river at bends with tendency to direct routes by natural cut-off, also the action of the river to increase erosion of bends to maintain original length. Gives evils existing in the Mississippi, noting obstruction to navigation by shoals, injury to alluvial lands by overflow, and destruction of banks by erosion. Discusses remedial measures by contraction of stream by spur dikes and training walls to scour shoals; by use of permeable dikes to induce fill and produce artificial banks; and by continuous revetment and submerged spurs. Describes work of improvement of Plum Point Reach, and Providence Reach. Discusses protection of bottom lands from overflow by confining the principle tributaries with reservoirs at their headwaters; by increasing the velocity of the river by constructing a new mouth 100 miles above present one; by constructing waste weirs; and by building artificial embankments (levees) to restrain the flood-water. Discusses bank protection work by mattress revetment, and spurs.

2. The discharge of the Mississippi River. *Amer. Soc. Civ. Engin., Trans.*, vol. 34, pp. 347-492, illus., Nov. 1895.

Presents in detail results of observations on the discharge of the Mississippi River. Includes discussion on tendency of sedimentary streams to bed regulation (stability), bed-load determinations, bed-load movement and conditions of scour and the transportation and deposition of material.

Discussion: T. G. DABNEY, (*Amer. Soc. Civ. Engin., Trans.*, vol. 35, pp. 308-310, July 1896), comments on the source of high water fill on bars and notes that the prevention of bank caving would result in greatly diminished deposition. THE AUTHOR, pp. 358-370, comments on the diminution of velocity by transportation of sand and gravel, noting that the quantity of matter in suspension is not sufficient to impair the fluidity of the water in the Mississippi. Gives highest recorded ratio, by weight, of sediment to water as 1 to 1935 while a ratio of 1 to 37 has been recorded for the Missouri River. Mentions the effect of bank erosion and its influence on bar building. Presents data on enlargement and contraction of a section at Arkansas City during high and low water years.

3. The transportation of solid matter by rivers. *Cornell Univ., Assoc. Civ. Engin.*, vol. 4, pp. 1-21, 1896-97.

Describes the characteristic behavior of sedimentary rivers in the transportation of solid materials; conditions of stream scour, transportation, and deposition; and factors affecting these conditions. Theories of sediment suspension are discussed. Behavior of the Mississippi River in relation to its ability to take up and transport solid materials of which its bed and banks are composed, and the sand wave movement are explained.

4. The floods of the Mississippi River. *Engin. News*, vol. 37, no. 16, pp. 242-247, illus., Apr. 22, 1897.

Discusses geologic and recent conditions of erosion and deposition in the Mississippi River Valley with particular reference to the floods of the Mississippi River. Discusses hydrographic influence on quantities of solid matter transported by the Mississippi River and its tributaries. Relative silt-bearing capacities of various tributaries are briefly described, noting diverse quality of sediment contributed to the Mississippi. Estimates silt

content, and discusses origin, characteristics, and conditions of transportation of silt of the Missouri and Arkansas Rivers.

5. The Mississippi flood of 1897. *Engin. News*, vol. 38, no. 1, pp. 2-7, illus., July 1, 1897.

Summarizes the effect of levees, cut-offs, and outlets, on the regimen of erosion and sedimentation in the Mississippi River. Reviews problem of raising and lowering of bed during floods. The efficiency of the levee system, its disadvantages, and the effect of levees in raising the bed of a stream are discussed.

6. The improvement of the South Pass of the Mississippi River. *Engin. News*, vol. 44, no. 8, pp. 121-125, illus., Aug. 23, 1900.

Describes the physical conditions of the mouth of the Mississippi River, and reports attempts at dredging the passes of the Mississippi by "stirring up" process. Gives history of improvements to the South Pass by jetty construction. Cites difficulties. Reports conditions of progressive shoaling of South Pass, dredging and movement of bed load as "sand waves" in the pass, also the deterioration of South Pass by silting. Describes the effect of crevasses on silting up of the pass; and the artificial scour by over-contraction. Silt deposition and scour behind jetties during construction and the settling of jetties due to compressibility of sand and silt on which they were constructed are discussed. The advance of South Pass Bar into the Gulf is reported.

7. The projected improvement of the Southwest Pass. *Engin. News*, vol. 44, no. 14, pp. 222-229, illus., Oct. 4, 1900.

An article in which are described conditions of the Mississippi River outlets with special reference to the Southwest Pass. Discusses principles of silt precipitation as influenced by the river and sea currents. Outlines changes in bar at mouth of the pass, and advances sundry factors contributing to such modification. Points out the inevitable evils of jetty construction on cross-section of the pass induced by forces of natural erosion and silting of channel. Reviews local phenomena of mud lump formation and movement of bars. Examines possible influence of dredging on jetty location. Expounds the theory of evolution of the pass and its application to the improved channel. Describes in detail theory of dredging, and notes instances of lasting improvement effected by dredging at a fraction of the cost of permanent works.

STEARNS, FREDERICK P. See Freeman, J. R., 1.
STEARNS, H. T.

1. (and Robinson, T. W., and Taylor, G. H.). *Geology and water resources of the Mokelumne area, California*. U. S. Geol. Survey, Water-Supply Paper 619, 402 pp., illus., 1930.

Report of a survey dealing with the geology and the water resources of the Mokelumne area, Calif. Includes two pages describing conditions of deposition of the younger alluvium in the Great Valley. The younger alluvium occupies a belt 10 miles wide and is being laid down at the present time by rivers which occasionally overflow their banks, leaving sand and silt on land. The maximum thickness of alluvium is probably not more than 200 to 300 ft.

STEARNS, NORAH DOWELL.

1. Laboratory tests on physical properties of water-bearing materials. U. S. Geol. Survey, Water-Supply Paper 596, pp. 121-176, illus., 1928.

Briefly describes methods and apparatus used in making tests of porosity, permeability, moisture equivalent, and mechanical composition. Considers the interpretation and use of the data obtained. Gives data on 97 samples, samples from Idaho being surface silt. Treats of mantle from some reservoir sites. Describes the method of taking unconsolidated samples volumetrically.

STEEL, THOS.

1. Transport of mud by a river in flood. *Chem. News*, vol. 105, p. 290, June 21, 1912.

A paper read before the Australasian Association for the Advancement of Science, Apr. 3, 1912 presents results of dissolved and sus-

pended load determinations of flood waters of the Yarra River, Victoria, made during July-August 1891.

STEELE, F. K.

1. The causes of floods [letter to editor]. *Cult. and Country Gent.*, vol. 49, no. 1634, p. 424, May 15, 1884.

Notes the effect of debris in backing up water and causing floods on small tributary of Smoky Hill Fork, Kans., also the effect of silt deposits on floods of large rivers. Advocates keeping outlets free and beds deep.

STEELE, J. G.

1. (and Bradfield, Richard). The significance of size distribution in the clay fraction. *Amer. Soil Survey Assoc. Bul.* 15, pp. 88-93, illus., May 1934.

Discusses various methods of determining size distribution of polydisperse systems. Outlines method of study used in an analysis of two soil profiles: the Elsworth silt loam, and the Miami silt loam. Clay was separated into seven fractions. Notes significance of size distribution.

STEIN, CHARLES P. See Camp, T. R., 2.

STEINMAYER, R. A.

1. Phases of sedimentation in Gulf Coastal Prairies of Louisiana. *Amer. Assoc. Petrol. Geol. Bul.*, vol. 14, pt. 2, no. 7, pp. 903-916, illus., July 1930.

A study of the recent material of the Gulf Coastal Prairies of Louisiana. On phases of sedimentation, especially with respect to environment. Notes that a better understanding of the environment will lead to the integration and correlation of sequence of sediment deposition. Shows that more than 500,000,000 tons of eroded material is transported by the Mississippi annually. The land in the lower Delta of the Mississippi is advancing at a rate of 300 ft. a yr. into the Gulf of Mexico.

2. Bottom sediments of Lake Pontchartrain, Louisiana [abstract]. *Amer. Assoc. Petrol. Geol. Bul.*, vol. 23, no. 1, pp. 1-23, illus., Jan. 1939.

Report presents results of a sedimentary analysis of the bottom sediments of Lake Pontchartrain, La. Briefly describes equipment used to obtain bottom samples.

STEINOUR, HAROLD H.

1. Rate of sedimentation, suspensions of uniform size angular particles. *Indus. and Engin. Chem., Indus. Ed.*, vol. 36, no. 9, pp. 840-847, illus., Sept. 1944.

Reports rates of sedimentation for suspensions of closely sized emery particles, flocculated and non-flocculated. Notes that a portion of the liquid suspension medium is carried down with the particles in their fall. Study is made to determine if this liquid is bound to particles or stagnant; shows evidence to support the latter view.

2. Rate of sedimentation, concentrated flocculated suspensions of powders. *Indus. and Engin. Chem., Indus. Ed.*, vol. 36, no. 10, pp. 901-907, Oct. 1944.

Reports rates of sedimentation for concentrated flocculated suspensions of various finely divided solids. New data support a rate equation previously found to be applicable to flocculated suspensions of uniform-sized emery powder.

STEPHENSON, E. G. See Senour, C., 3.

STEPS, W. E. See Hansen, O. C., 1.

STETSON, HENRY C.

1. (and Smith, J. Fred). Behavior of suspension currents and mud slides on the continental slope. *Amer. Jour. Sci. (ser. 5)*, vol. 35, no. 205, pp. 1-13, illus., Jan. 1938.

Discusses the behavior of suspension currents flowing down the continental divide as agents for the distribution and deposition of land sediments. Briefly discusses Daly's theory of density currents in connection with the origin of submarine canyons. Describes tank experiments on the distribution and deposition of density current sediments. Estimates quantities of suspended sediment required to cause density current flow down continental shelf. Effect of seepage resulting in submarine landslides is discussed in connection with the origin of submarine canyons.

2. Present status of the problem of submarine canyons. Amer. Phil. Soc., Proc., vol. 79, no. 1, pp. 27-33, Apr. 21, 1938.

Discusses the various theories in regard to the origin of submarine canyons. Treats of Daly's idea of density currents in cutting these canyons and the support of this idea by Kuenen.

3. German and Austrian papers on mechanical analysis. Natl. Res. Council, Div. Geol. and Geog., Com. on Sedimentation, Rpt. 1937-38, pp. 28-30, Sept. 1938.

A bibliography of 29 German and Austrian papers concerned with mechanical analysis.

STEVENS, J. C. See also Grover, N. C., 12; Kalinske, A. A., 2; Lane, E. W., 4; Sonderegger, A. L., 2; Taylor, T. U., 6.

1. Hydrometry as an aid to the successful operation of an irrigation system. Amer. Soc. Civ. Engin., Trans., vol. 71, pp. 314-341, illus., Mar. 1911.
Reports the use of current meter measurements as an aid to the successful operation of the Sunnyside irrigation project, Yakima River, Wash. Notes that water in most irrigation canals carries large quantities of silt causing continual changes in bed and banks, and consequently gradient of canal. Tumbleweed and thistles that have rolled into canal, weeds and moss growing in canal, and the sweet clover on banks, result in deposition of silt, causing backwater effect and retarding velocities. Discharge measurements with current meters indicate necessity for correction of canal obstructions.
2. The silt problem. Amer. Soc. Civ. Engin., Trans., vol. 101, pp. 207-250, illus., 1936; also in Amer. Soc. Civ. Engin., Proc., vol. 60, pp. 1179-1218, illus., Oct. 1934.

A comprehensive treatise pertaining to various subjects related to transportation and deposition of sediment. Gives the location, drainage area, water inflow, original capacity, year of capacity survey, age, and amount of sediment deposits for 25 different reservoirs in the United States and 7 foreign reservoirs. Offers detailed information concerning reservoirs in the United States, including Boulder, Ariz.; Elephant Butte, N. Mex.; Roosevelt, Ariz.; Keokuk, Iowa; Hales Bar, Tenn.; Parksville, Ocoee No. 1, Tenn.; McMillan, N. Mex.; Guernsey, Wyo.; Austin, Tex.; Worth, Tex.; Cucharas, Colo.; Cheoah, Tenn.; Sweetwater, Calif.; Chabot, Calif.; White Rock, Tex.; Boysen, Wyo.; Zuni, N. Mex.; Gibraltar, Calif.; Michie, N. C.; Sterling Pool, Ill.; Coon Rapids, Minn.; Furnish, Oreg.; Penick, Tex.; LaGrange, Calif., and Buckhorn, Colo. Presents tabulated suspended-load determinations for different streams in the United States and in several foreign countries. Discusses sedimentation and the effect of clarifying a sediment-laden stream. Outlines research conducted by different agencies relative to sediment transportation. Writer touches upon silt control by means of watershed protective works and by exclusion of silt from canals as exemplified by work in All-American Canal and canals in India. Comments on origin of silt and alluviation and degradation of valleys. Bibliography is included. Discussion: HARRY G. NICKLE, pp. 251-255, notes wide scope of Mr. Stevens' discussion and need for further research on volume and conditions of silt deposit, bed-load measurement, watershed characteristics, and other factors influencing transportation and deposition of silt. Cites particular need of more thorough investigation of exact behavior of floods through small reservoirs. Notes study of silt problem at 23 regular sampling stations and other locations in Texas since 1924. Describes Medina Reservoir and results of silt survey made in 1930. Gives dry weights, average specific gravity and mechanical analysis of suspended silt taken from Texas streams. Includes table of suspended-load measurements in various streams in Texas. E. W. LANE, pp. 255-261, notes growing importance of silt problem and present undeveloped state of science governing it. Briefly outlines growth of present knowledge

of subject from first approach by Guglielmini in seventeenth century to recent studies by various U. S. Government agencies and university laboratories. Compares problems in United States and foreign countries and emphasizes importance of silt in Chinese rivers. Cites Eliassen's report of maximum silt content of 51 percent by weight in Ching River, and in other Chinese rivers, silt content ranging from 23.09 to 39 percent by weight. Maximum in United States was 40.8 percent by weight in San Juan River. Gives two interacting groups of factors resulting in transportation of material by any section of a stream. Notes apparent difference between laws governing suspension and bed loads. Cites the two principle theories of suspension of solid material in water first published by Hooker about 1896. Discusses Depuit's theory and experiments. Explains phenomenon of streak of clear water surrounded by turbid water, and its importance as factor in mechanics of transportation of solids in suspension. FRANK E. BONNER, pp. 261-263, notes discrepancies in some of the data abstracted by Stevens. Writer does not share Stevens' and others alarm over hazards of reservoir silting. Notes tendency of mankind to provide acceptable substitutes for materials becoming scarce, citing examples. Notes accumulation of silt in Elephant Butte corresponds with forecasts prior to construction; says restoration of capacity is a problem for engineer of future when water storage requirement may be different. Compares various estimates of the average rate of surface leveling in United States based on silt movement. Recent data support writer's estimate of 933,000,000 tons annually while estimate of Federal Soil Erosion Service of 3,000,000,000 tons is thought to be excessive.

MORROUGH P. O'BRIEN, pp. 263-265, notes importance of silt problem and necessity for continued investigation in this field. States that any estimate of bed load must be made on basis of some arbitrary quantitative definition of that term. Discusses various factors to be considered in differentiating between bed load and suspended material. Notes that lack of precise data is obstacle to progress in application of theory of turbulent flow to distribution of suspended sediment and that additional data are needed before validity of Schmidt's basic equation can be fully established. Wide variation in silt deposits per thousand parts of water in various foreign and American reservoirs indicate necessity to divide problem into two phases; (a) volume of sediment transported by a stream; (b) characteristics of reservoirs as a silt trap. Discusses monetary loss caused by reservoir silting and suggests silt-controlling works as probable solution of problem. Presents tabulation of silting data on numerous foreign reservoirs and includes silting data on Medina, Wichita, Lock Raven, McKinney, and Holtwood Reservoirs in the United States. HARRY F. BLANEY, pp. 265-268, notes seriousness of silt problem to residents of Rio Grande Valley. State Planning Board of New Mexico reports danger of destruction of Rio Grande Valley due to rapid erosion and silting. Estimates silt endangers investment of \$100,000,000. Notes 1934 survey showing rises of 7 ft. in river channel at La Joya since 1918; at Albuquerque, 2 to 4 ft.; and at Alameda, 1 to 3 ft. Applies experiences on Rio Grande below Elephant Butte Dam to predict changes in bed of Colorado River and character of silt carried by stream after completion of Boulder Reservoir; believes annual silt load will be reduced by one-half at Imperial Valley intake. Notes difficulties and cost of using silty water in irrigation system of the Imperial Valley and cost per year for silt disposal. Cites experience of U. S. Bureau of Reclamation at Laguna Dam which indicates exclusion of 75 percent of former suspended load of silt from All-American Canal upon completion of Imperial Head-ing, with considerable reduction in annual expense for silt disposal. W. W. WAGGONER,

pp. 268-271, cites Stevens' tabulation of startling quantities of silt transported by various rivers and its indication of greater mud flow from sedimentary and fragmentary formations than from crystalline rocks. Proposes solution to problem of reservoir silting. Calls denudation one of grandest features of Creator's plan for maintaining fertility of soil, and quotes Prof. Hilgard's statement that soil is 3 to 5 percent organic and 95 to 97 percent inorganic matter, providing plants with nine necessary elements. Describes process of erosion on western slope of Sierras whereby flood waters fertilize California valleys. Compares early heavy production of wheat with today's low average of 1000 lb. per acre of poorer grain, due to depletion of plant food and failure to replenish by flooding. Traces settlement of Yuba drainage area from discovery of gold in California to exhaustion of forests in 30 yr. Describes floods resulting from 109 in. of rainfall in gold belt during winter 1861-62. In lower Yuba River Valley mud and sand buried farms and orchards 15 ft. deep. Surveys resulting from litigation showed extensive deposits of 600,000,000 cu. yd. ranging from 20 to 80 ft. in depth. Records dense growth of willows on deposit and quick covering of denuded areas with brush and pine. Notes wide application of lesson learned from debris deposit in Yuba River.

PHILIP R. R. BISSCHOP, pp. 271-277, compares importance of silt problems in South Africa and southwestern United States. Cites case of Sundays River as typical of serious conditions in South Africa. Describes Van Ryneveld's Pass and Lake Mentz Reservoir, their locations, catchment areas and effect of their operation on agriculture. Blames careless agricultural activities for conditions resulting in silting of Lake Mentz to 42.3 percent of its original capacity in 12 yr. and loss of 16.4 percent of capacity of Van Ryneveld's Pass in 8 yr. Explains influence of rainfall, topography and type of dam in varying results obtained in silt surveys. Expresses the opinion that proper agricultural practice combined with engineering control of river channels, construction of debris basins, and other protective steps, will result in reduction of 50 percent in volume of silt now carried by many streams.

HERMAN STABLER, pp. 277-284, emphasizes the importance of different geological types of rocks as sources of silt; stating that the chemical composition of rocks, relative speed of weathering and transportation and vegetation are factors in the silt problem, and that the effect of man's activities on the problem is incidental. Cites the value of silt data on the Colorado River and notes that the Plateau region contributes under 10 percent of the water and over 75 percent of silt. Describes the geology, topography, and vegetation of the region. With the average rainfall of 9.72 in over 5-yr. period it is believed futile to attempt the stimulation of vegetable growth on 60,000 sq. miles by supplying additional moisture. The possibility of controlling silt by regulating grazing, beneficial consumptive use of water, and construction of reservoirs and spreading works are considered. N. C. GROVER, pp. 284-286, mentions importance of information obtained regarding effect of Boulder Dam on silt regimen of Colorado. Gives quantities of silt, in millions of tons, and quantities of water, in acre-feet, carried by the Colorado River from January to June 1935, at Grand Canyon, Willow Beach and Topock gauging stations. Notes that apparent annual load of 200,000,000 to 300,000,000 tons of silt formerly carried to Yuma now is deposited in Boulder Reservoir. Resultant clear water discharged through dam deepens channel below reservoir by picking up new load. At Willow Beach station bed was appreciably lower in September 1935, than few months previously. Says subsequent deposition of new load in Parker Dam Reservoir indicates rapid depletion of its storage capacity. Cites value of lesson to be learned from controlled Colorado River. THE AUTHOR, pp. 286-288,

comments on discussion by Nickle who presented a summary of sediment loads of Texas streams, and who discussed the effect of drying silt in reducing its volume. Notes Lane's summary of silt investigations and factors affecting sediment load of streams, and the economic aspects of reservoir silting as discussed by Bonner. Gives Bisschop's data on silting of South Africa reservoirs and O'Brien's data on reservoir silting from Orth's paper. Cites Blaney on the effect of silt on plant life in canals and gives data by Waggoner on the effect of climatic and flood variations on silt deposition and sediment transportation. Reports Stabler's proposed use of preventive measures in controlling silting, and the effects of desilting the Colorado River at Boulder as discussed by Grover.

3. Models cut costs and speed construction. Civ. Engin., vol. 6, no. 10, pp. 674-678, illus., Oct. 1936.
Describes model tests at Bonneville Dam. Notes studies for the design of apron and baffles for the main spillway, cofferdams and fishways, cavitation tests for crest gates, backwater effects, and channel improvements. States that type of baffle adopted had been proven by experiments to be effective in the prevention of scour.
4. The effect of silt-removal and flow-regulation on the regimen of Rio Grande and Colorado Rivers. Amer. Geophys. Union, Trans., vol. 19, pt. 2, pp. 653-659, illus., Aug. 1938.
Discusses the effect of silt removal and flow regulation on the regimen below Elephant Butte Dam on the Rio Grande, and below Boulder Dam on the Colorado River. Data on annual runoff, flood peaks, and silt content of Rio Grande before and after regulation are given. Notes importance of sand bed-load problem at El Paso. Describes conditions of retrogression and aggradation below Elephant Butte Dam; aggradation above the reservoir; proposed rectification plan to counteract retrogression tendencies below dam. Treats amount of retrogression below Boulder Dam, effect of Parker Dam (under construction), Bullshead Dam (proposed), Imperial Dam (under construction) and Laguna Dam, probable silting up of Parker Reservoir, effect of proposed Headgate Rock diversion dam below Parker Dam, other influencing gradient above Imperial Dam, desilting operations at Imperial Dam, and regimen below Laguna Dam. Notes coarsening of river material below Boulder.
5. Silt problems of the West. Amer. Geophys. Union, Trans., vol. 20, pt. 1, pp. 26-32, illus., July 1939.
A paper read at the South Pacific regional meeting of the American Geophysical Union, Los Angeles, Calif., December 1938, on the silt problems in western United States. Discusses the social and economic aspects of reservoir silting. Lists storage reservoirs in the West that have lost 50 percent or more of their original capacity. Discusses conditions of normal geologic and man-induced erosion, noting means and effectiveness of preventive and remedial measures. The origin of silt, sedimentation as a phase of the geologic cycle, and conditions of the transportation and deposition of sediment are noted. The formation of valleys as a continuous succession of cycles of alluviation and degradation is discussed. Describes the arroyo conditions in Rio Puerco, Rio Chaco, and the Zuni River Valleys; noting causes of valley degradation. With reference to control of silt, the problems of retrogression below dams and desilting of irrigation waters are briefly discussed. Conditions of retrogression below Boulder Dam; value of desilting works at Imperial Dam, effects of silt removal from irrigation waters, conditions of building up of land by use of silt-laden irrigation waters, and the fertility of silt are reported.
6. Future of Lake Mead and Elephant Butte Reservoir. Amer. Soc. Civ. Engin., Trans., vol. 111, pp. 1231-1254, illus., tables and graphs, 1947; also in Amer. Soc. Civ. Engin., Proc., vol. 71, no. 5, pp. 603-626, illus., tables and graphs, May 1945.

A report which presents an analysis of sediment records for Elephant Butte Reservoir. From these data the useful lives of Lake Mead and Elephant Butte Reservoir are estimated. Discusses steps to prolong their useful life. Notes that Elephant Butte Reservoir is the only reservoir known for which an over-all value of the reservoir space occupied by sediment can be determined by a comparison of sediment inflow and sediments deposited. Points out that in the 10 yr. following 1935, some 1,500,000,000 tons of silt passed the Bright Angel Station in the Grand Canyon, Ariz., and also, that more sediment was contributed from the drainage area between the Grand Canyon and Boulder Dam. Five surveys of sediment deposits were made after the completion of Elephant Butte Reservoir. Presents data on sediment-load measurements including tables which show the amount of sediments deposited in Lake Mead and Elephant Butte Reservoir. To prolong the life of Lake Mead considers upstream storage of sediment, and gives estimated sediment deposition in the following proposed reservoirs: Bridge Canyon, Bluff, Coconino, Dewey, Glen Canyon, and Park Canyon. Notes that when Lake Mead is filled, it will contain 44,000,000,000 cu. yd. of sediment. No practical method of removing this enormous amount of sediment has yet been found.

Discussion: D. C. BONDURANT, pp. 1255-1256, believes that it is feasible to construct reservoirs above Elephant Butte, N. Mex. Notes effect of Salt Cedar as a sediment screen. JOHN H. BLISS, pp. 1256-1258, comments on points brought out by Mr. Stevens, and points out an erroneous statement made concerning the tri-state Rio Grande Compact. LUNA B. LEOPOLD, pp. 1258-1262, comments on the history of arroyo cutting of the Rio Puerco which characterizes the development of recent erosion in watersheds of the Southwest. Cites the work of Kirk Bryan and G. M. Post on the Rio Puerco. Considers the value of watershed cover for protecting water supply and preventing erosion. CARL B. BROWN, pp. 1262-1269, indicates that estimates of silting in Lake Mead by Mr. Stevens are low, the period of record is not adequate as an index of the long period; comments on bed load at Grand Canyon; sediment from intervening drainage area; and space occupied by deposits in Lake Mead. Two factors accounting for the decline in sedimentation in Elephant Butte Reservoir are given. Discusses methods of prolonging the life of Southwestern reservoirs. G. E. P. SMITH, pp. 1270-1273, treats rainfall and runoff in the area. Notes the desirability of building Dewey Dam, and tunnels on dams, such as Boulder, to eliminate silt. ALBERT E. COLDWELL, pp. 1273-1277, considers that the life of Lake Mead is less than that of Elephant Butte Reservoir, and notes that methods of estimating lives of the reservoirs may be too severe for the latter part of their lives. Discusses sedimentation in Lake McMillan. WALTER B. LANGBEIN, pp. 1277-1280, treats the question of how representative of long-term conditions are the loads now being measured in streams. Considers the problem of arroyo growth. C. S. HOWARD, pp. 1280-1282, gives data on suspended load on various stations in the Colorado River basin. Notes the amount of solids dissolved and the amount of solids precipitated during storage in Lake Mead from Feb. 1, 1935 to Sept. 30, 1944. CHARLES KIRBY FOX, pp. 1282-1287, gives a table showing various estimates by different individuals of the silt load of the Colorado River. Treats the estimating of silt load from annual runoff data. Comments on estimating the silt load of the Colorado. H. V. PETERSON, pp. 1287-1293, considers the control of erosion, growth of gullies, and prevention of silting. L. C. CRAWFORD, and P. C. BENEDICT, pp. 1293-1295, comment on the work of the Interdepartmental Committee on developing equipment and methods of sediment sampling. Give data on suspended load at Cedar River at

Cedar Rapids and Iowa River at Iowa City for the water year 1943-44. CHARLES P. BERKEY, pp. 1295-1297, points out the need and value of recovering lands by irrigation. STAFFORD C. HAPP, pp. 1297-1300, comments on effects of delta growth in the reduction of reservoir sedimentation. Points out that there is a serious sediment problem in the Rio Grande Valley above Elephant Butte Reservoir. BERARD J. WITZIG, pp. 1300-1302, treats the problem of determining the useful life of a reservoir. Comments on land management as a measure to prolong the life of the reservoirs. Points out need to study density currents as a means of voiding sediments from reservoirs. HUGH STEVENS BELL, pp. 1302-1312, presents a detailed analysis of the weight-volume problem and a discussion and interpretation of sedimentation data at Lake Mead for the 10 yr. ending in 1945. E. W. LANE, pp. 1312-1315, points out three factors on which the future of these reservoirs depends from the standpoint of sediment deposits. Comments on sedimentation in the two reservoirs and determination of their life. F. E. BONNER, pp. 1315-1316, points out that the accumulation of alluvial debris in Lake Mead will transform it into a vast ground-water storage reservoir, and that the actual water-holding capacity of the reservoir will not be reduced more than 40 percent of its original capacity. Large losses by evaporation will be avoided. JOE W. JOHNSON, pp. 1316-1319, deals with the general problem of the disposal of silt created by erosion. Points out that the permanent method of preventing silting in a reservoir would be to bypass the silt. Notes value of a plan to provide means to accumulate sediment in one part of a valley and the raising of the valley floor for long periods of years, and during other periods do the same to other parts of the valley floor. HAROLD H. MUNGER, pp. 1319-1320, calls attention to four factors concerned with reservoir silting. WILLIAM MAYO VENABLE, pp. 1320-1321, notes that the only way to prevent silting in a reservoir is to bypass the silt. EDWARD GERALD SMITH, pp. 1321-1324, comments on errors of sediment measurements. Notes need of more accurate samplers and improved field practices. Discusses factors and methods in prolonging the life of reservoirs. CLARENCE S. JARVIS, pp. 1324-1330, notes that bed-load contributions have upset earlier estimates of life of the two reservoirs. Points out that the "bank storage" capacities of reservoirs and the storage of water within the coarser sedimentary deposits of a nearly filled reservoir may retain 50 percent of the originally gaged storage volumes indefinitely. STANDISH L. HALL, pp. 1330-1338, points out danger of sedimentation to irrigation in the West. Discusses the production of sediment by erosion and the deposition of sediment in reservoirs. Considers various measures of prolonging life in reservoirs; such as land management and use of density currents. THE AUTHOR, pp. 1338-1342, presents rejoinders to only a few of the 24 discussers. Points out that the best land-management programs could not make important reductions in sediments carried by the streams. Cites Mr. Kirk Bryan who shows that the problem of arroyo cutting which began in the 1880's after misuse of the land by stockmen had occurred before the coming of the white men; there having been at least three periods of alluvium deposition and arroyo cutting. Arroyo cutting may be affected by grazing, but it occurs independently of the misuse of land by grazing. Discusses factors used to estimate the useful life of Lake Mead, and comments by discussers on the validity of these factors used in estimating the life. In conclusion points out the need of a program of research by State, Federal, and private agencies to acquire basic data before plans can be made to combat the silt menace.

STEVENS, O. P.

1. The embankments of the Mississippi River [letter to editor]. Sci. Amer. Sup., vol. 1, no. 14, p. 211, Apr. 1, 1876.

Letter to editor refers to an article in Scientific American Supplement by Eads and quoting Principles of Geology by Lyell, Ed. 9, pp. 255-256, on artificial embankments of Italian rivers. Effects of embankments are to increase stream velocity, thereby causing the conveyance of larger portions of solid matter to the sea, however, the deposition of sand and mud in river channels necessitates continual removal of deposits and increased bank heights. Notes that practice of embankment was employed on some Italian rivers in the thirteenth century.

STEVENS, R. B.

1. Hydraulic sluicing for blanketing porous canal banks, Sun River project. Reclam. Rec., vol. 9, no. 3, pp. 125-127, illus., Mar. 1918; [abstract], Engin. and Contract., vol. 49, no. 12, pp. 298-299, Mar. 20, 1918.

Describes methods utilized to blanket with silt the canal banks of Pishkun Canal, Sun River project, to avoid continued leakage. Hydraulic sluicing methods are employed to induce artificial silting.

STEVENSON, CHARLES H.

1. The shad fisheries of the Atlantic Coast of the United States. U. S. Comm. Fish and Fisheries, Rpt., (1898) pt. 24, pp. 101-269, 1899.
A technical report on the shad fisheries of the Atlantic Coast. Briefly notes the effect of sediment transportation and deposition in streams upon the migratory habits of fish.

STEVENSON, DAVID.

1. On the reclamation and protection of agricultural land. 70 pp., illus. Edinburgh, A. and C. Black, 1874.
Deals with the protection of land from the wasting action of river, the prevention of flood overflows, the reclamation and protection of tidal lands situated on estuaries, and the protection of sea shores against the action of waves. Includes discussion on "warping" as a process of reclamation. Gives the amount of matter held in suspension in different estuaries, and the rate of land development by tidal deposits.

STEWART, G. R.

1. The Punjab plans—a coordinated attack. Soil Conserv., vol. 3, no. 1, pp. 14-17, 21, illus., July 1937.

Describes conditions of erosion in the Punjab, and enumerates the chief causes. Evidence of erosion is seen in the silting of irrigation canals, ditches and reservoirs. Control measures are outlined, noting especially the employment of sedimentation basins, or "Bandhs."

STEWART, GEORGE. See Watts, L. F., 1.

STEWART, J. L.

1. Protecting stream banks against erosion [abstract]. Engin. and Contract., vol. 69, no. 6, pp. 243-244, illus., June 1930.

An abstract of a paper by J. L. Stewart presented at the 1930 Purdue Road School describing methods for stream bank protection. Retard method of inducing silt deposits, and use of concrete mattresses (by Miami Conservancy District), stone mattresses, pile dikes, stone baskets, steel sheet piling (Big Cedar Creek, Franklin County, Ind.), and concrete curtain walls are briefly described.

STEWART, RALPH W.

1. Self foundation depths for bridges to protect from scour. Civ. Engin., vol. 9, no. 6, pp. 336-337, illus., June 1939.
Gives records of bridge failures resulting from scour and debris on bridge foundations during the flood runoff of March 1938, in southern California. Scouring of sand deposits, formed when mouths were plugged with dune sand at low stages, is given as cause.

STINY, JOSEF.

1. Der Schweb der Mur, Steiermark (Suspended matter in the Mur, Styria). Ztschr. f. Geomorph., vol. 1, no. 1, pp. 49-53, 1925. In German. Translation on file at the U. S. Soil Conservation Service, Washington, D. C.
Gives data on the suspended load in the Mur, Styria, and notes amount of denudation, etc.

STOCKFORD, J. A.

1. Suggestions for utilizing the silt of the Mississippi River [letter to editor]. Sci. Amer., vol. 99, no. 5, p. 75, Aug. 1, 1908.

Discusses the fertilizing value of Mississippi River silt and describes a method for the collection and the spreading of silt on land without the use of water.

STOCKTON, ROBERT S. See Fortier, S., 2.

STOKES, GEORGE GABRIEL.

1. On the effect of the internal friction of fluids on the motion of pendulums. Cambridge Phil. Soc., Trans., vol. 9, pt. 2, pp. 8-106, 1851.

The paper sets forth Stokes' law of viscous resistance. Investigates theoretically the motion of a solid sphere falling freely under gravity in a viscous fluid; the sphere will attain a constant terminal velocity when the effective weight equals the resistance consequent on the viscosity of the fluid. Discusses mathematically the effect of the internal friction of fluids on the motion of pendulums. The paper is devoted mainly to the solution of the problem in the two cases of a sphere and a long cylinder, and a comparison of the results with experiments of Baily and others. Contains two applications of the theory of internal friction to problems which are not related to pendulums. Notes that the resistance of a sphere moving uniformly in a fluid can be acquired as a limiting case of the resistance to a ball pendulum, as long as the square of the velocity is neglected, this resistance proves to be proportional, for a given fluid and given velocity, to the radius of the sphere so the accelerating force of the resistance increases as the sphere radius decreases, therefore the resistance of a minute globule falling through air with its terminal velocity depends on the internal friction of air. The terminal velocity can be calculated for a globule of a given size if the part of resistance which depends on the square of the velocity is neglected. Presents an equation which is applied to determine the terminal velocity of a globule forming part of a cloud.

2. Mathematical and physical papers. Vol. 3, 413 pp. Cambridge, Eng., Univ. Press, 1901.

Consists of a collection of papers written by G. G. Stokes. Stokes' formula for the terminal velocity of a sphere falling through a viscous fluid, or Stokes' law of viscous resistance, is given on page 60 in an article entitled On the Effect of the Internal Friction of Fluids on the Motion of Pendulums, which was published in Transactions of the Cambridge Philosophical Society, vol. 9, 1851.

STONE, C. H.

1. Analysis of Mississippi River silt. Science n. s., vol. 23, no. 590, pp. 634-635, Apr. 20, 1906.
Presents results of a chemical analysis of the Mississippi River sediment. Estimates annual amount and value of plant-nutrient material carried in the sediment of the Mississippi.

STONE, LIVINGSTON.

1. Report of operations at the United States Trout ponds, McCloud River, California, for the season of 1881. U. S. Comm. Fish and Fisheries, Rpt., pt. 9, pp. 1079-1083, 1881.
Describes the effect of an invasion of mud, borne by the McCloud River, Calif., following the heavy rains of January 1881, upon fish life in the trout ponds on the stream.

STONE, WILLIAM L.

1. Archaeological discovery. Remains of an ancient Indian work on Fish Creek, near Saratoga Springs, N. Y. Mag. Amer. Hist., vol. 5, no. 1, pp. 34-36, July 1880.

Gives an account of silting in of a swamp adjacent to Fish Creek in the vicinity of Victory Mills, N. Y., where 15 yr. previously 10 ft. of water had existed.

STOREY, H. C. See Dodge, B. H., 1; Wilm, H. G., 1.

STOUT, IVAN M. See Bloodgood, D. W., 10-11.

STOW, MARCELLUS H.

1. A preliminary investigation of some sediments from James River, Virginia. Amer. Min., vol. 15, no. 11, pp. 528-533, Nov. 1930.

Report on a preliminary investigation of the heavy mineral content of the James River sediments and its relation to the characteristic rocks existing in the watershed. Area covered extends from between the towns of Vesuvius on the North Branch, and Clifton Forge on the

main James River, to a point 5 miles below Lynchburg. Samples were taken at Lick Run, Eagle Rock, Sherwood Station, Wilson Falls, Balcony Falls, Rocky Row Run, Pedlar River, and Mt. Athos, and were analyzed to determine the percent of limonite, ilmenite, tourmaline, zircon, rutile, amphibole and pyroxene, epidote, leucoxene, garnet, kyanite, mica, staurolite, and fine micaceous grains. Data were tabulated and discussed. Conclusions were drawn.

2. Reflection of provenance in heavy minerals of the James River. *Jour. Sedimentary Petrology*, vol. 9, no. 2, pp. 86-91, illus., 1939.

A study of sand samples collected from the James River of Virginia, between Clifton Forge, Allegheny County, and Smithfield, Isle of Wight County. A correlation is shown between the stream sediments and the country rock.

STRANGE, WILLIAM LUMISDEN.

1. Indian storage reservoirs with earthen dams. Ed. 3, 498 pp., illus. London, G. Rutledge & Sons, Ltd., 1928.

Discusses the peculiar conditions to be considered in the construction of storage reservoirs with earthen dams in tropical India. Considers the silting of reservoir beds, the necessity and methods for the reduction of silt deposits and the classification of silt deposits in reservoirs. The proportion of silt to water and methods of determining the amount of silt deposited in reservoirs are noted. The advantages of earthen compared with masonry dams with respect to the silt problem are considered.

STRAUB, LORENZ G. See also Brown, C. B., 12;

Chang, Y. L., 1; Kalinske, A. A., 12; Kramer, H., 2; Vogel, H. D., 8.

1. Hydraulic and sedimentary characteristics of rivers. *Amer. Geophys. Union, Trans.*, vol. 13, pp. 375-382, illus., June 1932.

A paper briefly summarizing results of investigations on the relationship between conditions of stream flow and characteristics of sediment load in open channels. Discusses the distribution of suspended sediment in stream cross-section. Compares the relationship between water discharge and sediment transported in suspension, giving a comparison of monthly water discharge and suspended discharge for Missouri River past Kansas City (May 1929-June 1930). Reports observations on the retention of material transported in suspension (Missouri River at Kansas City and Waverly). Gives factors affecting the nature of suspended sediment throughout river cross-section, and notes movement of bed load as influenced by direction and velocity of flow. Discusses proposed theory of the determination of amount of bed load of streams; comparing theory with experiments of Gilbert, Schaffernak, and others, also with empirical equations for non-silting and non-scouring conditions.

2. On dynamics of streams. *Amer. Geophys. Union, Trans.*, vol. 14, pp. 379-388, June 1933.

Describes the investigations of the Hydrology Section of the American Geophysical Union on the dynamics of streams. Discusses important developments relative to the action of surface flow and flow in natural channels, and investigations dealing with laboratory studies of flow conditions in natural water courses. Studies aimed to reduce damaging effects of soil erosion as a result of topsoil removal and the deposition of erosional debris upon lowlands and in streams and reservoirs. Describes the hydraulic characteristics of rivers, reports investigations on characteristics of bed-load movement and the measurement of suspended load of streams. Appendixes list hydraulic laboratories throughout world, organizations whose work is related to river hydraulics and stream dynamics.

3. Effect of channel-contraction works upon regimen of movable bed-streams. *Amer. Geophys. Union, Trans.*, vol. 15, pt. 2, pp. 454-463, illus., June 1934.

Considers the quantitative determination of the effect of contraction works on the regimen of moveable streams beds. Discusses the theory of flow in contracted channels, and presents formulas for the quantity of sediment transported along stream bed in terms of discharge and slope in an idealized rectangular channel of infinite breadth. Theoretical equations for depth in a contracted section in terms of flow conditions in uncontracted section, and for resulting non-scouring and non-silting velocities are given. Experimental evaluation of sediment characteristics, transporting force, and roughness coefficient as parameters in theory of sediment transportation is described. Verifies experimentally the effect of contraction works on the regimen of flow in open channels with erodible beds, noting similarity of theoretical and experimental equilibrium profiles. Discusses effect of channel contraction on discharge rating curves. Compares field data (Missouri River at Kansas City) with theoretical analysis.

4. Report of the Committee on Dynamics of Streams 1934-35. *Amer. Geophys. Union, Trans.*, vol. 16, pt. 2, pp. 443-451, Aug. 1935.

A report briefly summarizing current research concerning ice formation in rivers. Discharge formulas, sediment transportation by rivers, bed load, suspended load, scour, and soil erosion are considered. Model studies of problems of stream dynamics, potential flow, flow around obstructions, flow in curved channels, and non-uniform flow in open channels are noted. Phenomena of hydraulic jump, hydraulic rollers, flood movements, wave motion, stage oscillation in water courses, turbulence, and viscosity are discussed. A bibliography is included.

5. Some observations of sorting river-sediments.

Amer. Geophys. Union, Trans., vol. 16, pt. 2, pp. 463-467, illus., Aug. 1935.

Reports observations on the sorting of river sediments during transportation by flowing water. Describes laboratory studies of the sorting process conducted in the hydraulic laboratory at University of Minnesota, showing results by means of graphs. Detailed field investigations in the Missouri River at Baltimore Bend to determine relation between flow conditions and nature of stream bed are described. Studies made include velocity-observations by floats, soundings to map stream bottom, the collection of bed-sediment samples to determine distribution of various classes of sand within river bed, and line of levels along shore. Results of studies are given.

6. Transportation of sediment in suspension. *Civ. Engin.*, vol. 6, no. 5, pp. 321-323, May 1936.

Reports the experimental and theoretical determinations of suspended silt load of streams, particularly the Missouri River at Kansas City. Includes discussion of factors influencing suspension and transportation of silt and bed load. Notes that change in chemical composition of water affects dispersion at Kansas City, as compared with Omaha. Suspended silt load is usually less than 2 percent by weight. Model studies of sedimentation basin at University of Minnesota show that for Reynolds' number over 200, the model could be operated at any of a large range of velocities, without affecting efficiency. Sediment load at Kansas City and Waverly (80 miles downstream on Missouri River) are almost identical, indicating that the river retains its sediment in suspension. Loading of river is shown to vary with the stream discharge. Empirical relation for this variation is developed.

7. Observations and analysis of the suspended load of rivers. *Internat. Assoc. for Hydraulic Structures Res. Rpt.*, (1937) 1, pp. 153-160, illus., Jan. 1, 1938.

Describes and discusses the technique of observations and studies made to determine the suspended load of the Missouri River and its tributaries. Silt sampling methods and equipment and procedure of laboratory analysis are reported. Distribution of suspended matter in stream cross-section and mechanical composition of suspended load are given.

8. A practical theory of detritus transportation and design of stable channels. In Internatl. Assoc. Hydraulic Res., Liege, France, 1939, Rpts. and Papers for the Postponed Meeting, pp. 37-69. Stockholm, Askar Eklund's Boktryckeri, 1940.
Presents a general method of analysis of open channels in erodible granular beds. Bulk flow and detritus transportation factors are used as an approach to the theory. The proposed theory is in its general form the same as the results of experimental work by noted investigators. Gives a method for computing the amount of debris moved along the bed of a river and an analytical explanation of the shifting of the discharge rating curves for alluvial-bed rivers. Determines values for tentative use for alluvial bed rivers. Determines values for tentative use for the parametric characteristics for the transportation of various river sediment grades.
 9. Approaches to the study of the mechanics of bed movement. Iowa Univ., Studies in Engin., Bul. 20, pp. 178-192, illus., Mar. 1940.
An article focusing attention on various observations which stress important considerations in the practical study of bed-load movement. Considers the character of river sediments, giving typical examples. The complexities of the problem of sorting of grains in sediment transportation experiments are discussed. Presents a theory which enables the estimation of variations in stream bed for changes in flow conditions. Application of theory to explain equilibrium conditions for channel contraction works is made.
 10. Committee on dynamics of streams, 1939-40. Amer. Geophys. Union, Trans., vol. 21, pt. 2, pp. 443-450, July 1940.
A report presenting results of studies by members of the Sub-Committee on Land Forms with a view to securing evidence of aggradation or degradation in the lower Mississippi, and on the subject of stable channels of streams. Includes a bibliographic review relating to sediment transportation and related phenomena.
 11. Progress in hydraulics as related to sedimentation 1939-40. Natl. Res. Council, Div. Geol. and Geog., Com. on Sedimentation, Rpt., 1939-40, pp. 70-85, Dec. 1940.
Reviews briefly the work accomplished in hydraulics as related to sedimentation during 1939-40. Notes various conferences which have treated the problem of sediment transportation by rivers and related occurrences. Comments on river-model studies, laboratory studies of bed load and suspended load, turbulence as related to sediment transportation, and the mechanical analysis of sediment. Includes a bibliography of 112 articles pertaining to the field.
 12. Mechanics of rivers. In Physics of the earth IX. Hydrology, pp. 614-636, illus. New York, McGraw-Hill Book Co., Inc., 1942.
Discusses such subjects as river beds, mode of detritus movement, river gradient, suspended load, the turbulence theory of suspended-load transportation, bed load, retention of sediment in suspension, and river-bed changes. Includes data on suspended load carried by the Missouri River past Kansas City.
 13. River navigation extended by open-channel expedients II. Discharge and sediment relationships in an open channel. Civ. Engin., vol. 16, no. 11, pp. 490-491, illus., Nov. 1946.
Comments on transportation of suspended load and river-bed sediment. Gives a theoretical curve represented by an equation which shows discharge and sediment relationship for the Missouri River at Kansas City. Gives an equation for bed-load movement.
- STRELE, G.
1. Die Bewegung des Wassers und des Geschiebes (The motion of water and silt). In his Grundriss der Wildbachverbauung, pp. 41-53, illus. Wien, Julius Springer, 1934. In German. Translation on file at the U. S. Soil Conservation Service, Washington, D. C.
Cites formulas and discusses the fundamentals of the theory of water and silt motion.
2. Fünfzig Jahre erfahrungen bei der Wildbachverbauung in Österreich (Fifty years' experience with mountain stream control in Austria). Wasserkr. u. Wasserwirtsch., vol. 31, no. 6, pp. 61-65, Mar. 1936. In German. Translation on file at the U. S. Soil Conservation Service, Washington, D. C.
Reviews methods and forms of construction used in the control of mountain streams by the Austrian Forest Service. Notes methods used to reduce the amount of material carried by streams.
- STROEBE, G. G.
1. Some hydrological facts concerning the Yangtse. Assoc. Chinese and Amer. Engin., Jour., vol. 6, no. 5, pp. 22-31, illus., May 1925.
Presents results of observations by the Yangtse River Commission dealing with the various hydrological problems of the Yangtse River. Includes brief discussion on changes in Yangtse River bed elevations (siltation and scouring) and on results of silt content observations of the Yangtse at Hankow, 1923.
 2. Hydrological data compiled by Yangtse River Commission. Assoc. Chinese and Amer. Engin., Jour., vol. 10, no. 3, pp. 25-29, Nov. 1929.
Describes the work of the Yangtse River Commission. Briefly presents various hydrological data compiled by this agency. Describes study by Commission on available navigation depths in the stream. Silt content of Yangtse at Hankow averages about 500 parts per million.
- STROM, H. G.
1. Control of rivers. Commonwealth Engin., vol. 24, no. 5, pp. 166-173, Dec. 1, 1938.
Describes river control in New Zealand, noting the use of dikes, groynes, willow and stone mattresses, porous and impervious dikes, channel control and bank protection works. Protection of banks of the Waitaki, Little Wangani, West Coast, Ashley, Wamakariri, Hutt, Clutha, Oreti, Waimea, Tutaeiki, Waikau, and Lower Manawatu Rivers are noted. Conditions are compared with those of Victoria, Australia.
 2. Control of rivers. II. Commonwealth Engin., vol. 26, no. 6, pp. 210-220, illus., Jan. 2, 1939.
Describes river control in New Zealand, noting the use of dikes, groynes, mattresses, channel control and bank protection works. Discusses control of shingle-laden rivers. Notes the works on Waimakariri, Ashley, Hutt, Tambo, Rakaia and Waitaki Rivers in New Zealand.
 3. River control in New Zealand and Victoria. 131 pp., illus. Melbourne, State Rivers and Water Supply Commission, 1941.
The characteristics of the New Zealand rivers are discussed. Work of river control, including flood prevention, bank protection, improvement of channels, and sundry works is described. Legislation affecting river control in New Zealand is noted. Effect of mining and erosion on New Zealand rivers, river control works in Victoria, powers of authorities and problems of river control, comprehensive river surveys, and maintenance of streams and their catchments are discussed.
- STROM, KAARE MÜNSTER.
1. Land-locked waters and the deposition of black muds. In Trask, P. D., ed. Recent marine sediments; a symposium, pp. 356-372, illus. London, T. Murby and Co., 1939.
An illustrated article which is a condensation of two papers entitled Land-Locked Waters—Hydrography and Bottom Deposits in Badly Ventilated Norwegian Fjords with Remarks upon Sedimentation under Anaerobic Conditions (Skr. Norske Vidensk.-Acad. Oslo, 1(1936), 7, pp. 1-85) and Two Land Locked Fjords in Northern Norway, (ibid, (1937), 7, pp. 1-12). Describes hydrography in a typical land-locked Norwegian fjord; conditions of stagnation. Saline ocean waters entering fjords sink to bottom due to relatively greater density and river water floats on top; poor ventilation of bottom saline waters causes a consumption in its oxygen content forming hydrogen sulphide; hydrogen sulphide in contact with remains of organic matter produces black bottom deposits. Summarizes investigations in Norwegian fjord with

STROM, KAARE MÜNSTER. - Continued

reference to hydrography, features of the stagnation process, conditions conducive to permanent content of hydrogen sulphide in bottom waters of a coastal basin, and the development of deposits under anaerobic conditions. Deposition of black mud in other areas of stagnant water; Black Sea and numerous lakes in the tropics. Past conditions in oceans basins producing hydrogen sulphide. Probable deposition by this process of black shales, such as are found in early Paleozoic deposits. List of references.

STUTZ, G. F. A.

1. (and Pfund, A. H.). A relative method for determining particle size of pigments. *Indus. and Engin. Chem.*, vol. 19, no. 1, pp. 51-53, illus., Jan. 1927. Describes an apparatus developed to measure accurately the relative average particle size of a pigment by the determination of the opacity of a suspension of the pigment.

STUTZMAN, L. F. See McMillen, J. H., 1.

SUBRAHMANYAN, V.

1. Some aspects of the chemistry of swamp soil. *Current Sci.*, vol. 5, no. 12, pp. 656-659, June 1937. Presents a review of existing knowledge on the relation of the chemistry of swamp soil to rice cultivation. Briefly notes the effect of silt deposition on yields of rice.

SUDLER, EMORY.

1. A few statistics about Baltimore's water supply. *Engin. Club, Baltimore, Mo. Jour.*, vol. 1, no. 8, pp. 6-7, 10, June 1912. Presents data on the water supply of Baltimore, Md. Notes that deposits in Loch Raven have reduced its capacity from 500,000,000 gal. to about 200,000,000, 1881-1912, even though more than 2,000,000 cu. yd. of silt have been removed within the past 10 yr., 1902-1912. The present, 1912, capacity of Lake Roland which has been considerably reduced by silt accumulations, is about 300,000,000 gal.

SULLIVAN, W. F. See Jacobson, A. E., 1.

SUMERFORD, S. D. See White, A. M., 1.

SUMMER, FRANCIS B.

1. (and others). A report upon the physical conditions in San Francisco Bay, based upon the operations of the United States Fisheries Steamer "Albatross" during the years 1912 and 1913. *Calif. Univ. Pub. Zool.*, vol. 14, no. 1, pp. 1-199, illus., July 29, 1914. George D. Louderback, Waldo L. Schmitt, and Edward C. Johnston, joint authors. Presents the results of observations, 1912-13, on the physical conditions in the San Francisco Bay. Includes descriptions of bottom sampling apparatus employed during operations.
2. (and Smith, Osgood R.). Hydraulic mining and debris dams in relation to fish life in the American and Yuba Rivers of California. *Calif. Fish and Game*, vol. 26, no. 1, pp. 2-22, illus., Jan. 1940. A summary of report entitled A Biological Study of the Effect of Mining Debris Dams and Hydraulic Mining on Fish Life in the Yuba and American Rivers in California, by F. H. Sumner and O. R. Smith, Stanford University, 1939 (Mimeog.). Survey made during summer and fall of 1938 to determine the effect on fish life by the renewed hydraulic mining operations, with the attendant construction of debris dams in the American and Yuba River basins. Results of observations on the effect of silty or muddy water on fishes, and the effect of mining debris on fish foods are presented.

SUTTON, C. W.

1. Andean mud slide destroys lives and property. *Engin. News-Rec.*, vol. 110, no. 17, pp. 562-563, Apr. 27, 1933. Describes the slide at Charat, Peru, which is typical of periodic slides or "huaicos" which are caused by heavy rains that wash powdery overburden from the hills into gulches and form rivers of mud.

SVEDBERG, THE. See also Stamm, A. J., 1.

1. (and Nichols, J. Burton). Determination of size and distribution of size particles by centrifugal methods. *Amer. Chem. Soc. Jour.*, vol. 45, no. 12, pp. 2910-2917, illus., Dec. 1923.

Modifies Stokes' law to give an exact formula for determining the radius of a particle sedimenting under centrifugal force. Describes a type of centrifuge which permits a sol to be observed and photographed during precipitation. Discusses a method for determining the distribution of size particles, which is dependent upon the variation of concentration with distance from the axis of rotation in a disperse system which has been subjected to centrifugal force.

2. Colloid chemistry. 265 pp., illus. New York, Chemical Catalog Co., Inc., 1924.

Based on a series of lectures given at the University of Wisconsin during the spring and summer of 1923. Attempts to give a general survey of colloid chemistry. Considers such subjects as formation of the colloid particle, the colloid particle as a molecular kinetic unit, the colloid particle as a micell, and the destruction of the particle. Notes the method of determining particle size by measuring the velocity of sedimentation, and reports other methods. Comments on Stokes' law and apparatus for the automatic registration of sedimentation.

3. (and Pedersen, Kai O.). The ultracentrifuge. 478 pp., illus. Oxford, Clarendon Press, 1940.

A monograph which considers the theory of sedimentation, construction and operation of ultracentrifuges, details and methods of measurement, and results obtained from Svedberg ultracentrifuges. Notes that with precise measurements in strong centrifugal fields it is possible to deduce values for molecular weights of substances such as proteins and polysaccharides.

SWAIN, GEORGE F.

1. The influence of forests upon the rainfall and upon the flow of streams. *New England Water Works Assoc., Jour.*, vol. 1, no. 3, pp. 11-26, Mar. 1887. Deals with the influence of forests on climate, precipitation, and stream flow. Includes brief discussion on the effect of forests on the sediment content of streams. Notes that the Mississippi River carries annually to sea 406,250,000 tons of sediment; the River Po, 55,000,000 cu. ft. of silt, and the Ganges River system carries 40,000,000 cu. ft. in 4 mo.

SWANSON, CAROLINE H.

1. The ecology of Turkey Run State Park I. The flood plain. *Ind. Acad. Sci., Proc.*, vol. 38, pp. 165-170, 1928. Discusses the bionomics of Turkey Run State Park, Ind. Describes conditions of transportation and deposition of sediment by Sugar Creek. The character of stream banks and the conditions of flood plain development.

SWAREN, J. W.

1. Silt settled from power stream to prevent turbine erosion. *Engin. News-Rec.*, vol. 78, no. 6, p. 298, May 10, 1917. Describes method of settling silt to prevent erosion of turbine parts at Pacific Power and Light Co., on White River, Ore. Notes abrasive effect of silt on rivet heads, buckets, and shafts. Describes silt settling chambers and observes that the settling of silt has eliminated wear.

SWARTLEY, A. M.

1. Extracts from report on Rogue River turbidity. *Oreg. State Dept. Geol. and Min. Indus. Bul.* 10, app. A, pp. 26-27, 1938. A report pertaining to the Rogue River turbidity, Appendix A to Placer Mining on Rogue River, Oregon, in its Relation to the Fish and Fishing on that Stream (Ward, H. B., 1). Describes methods of transportation of material by traction and in solution and suspension. The effect of stream velocity is noted. Recounts stream bed, bench and valley deposits giving origin and nature. Discusses movement of bed material, noting its composition and the effect floods have on its movement. Describes size distribution of material carried in suspension, and as colloids. Notes that transported material does not affect oxygen content of water; and that it has no toxic or injurious effect on fish or fish life. Gives average turbidity range in parts per million of Rogue River at Copper

Canyon, Oreg.; Snake River at Weiser, Idaho; Owyhee River, at Owyhee, Oreg.; Klamath River at Klamath Falls, Oreg.; Umatilla River at Umatilla, Oreg.; John Day River at McDonald, Oreg.; Columbia River at Cascade Locks, Oreg.; Colorado River, (flood conditions), and at the Rio Grande River.

SWARTOUT, W. C. See Fristoe, R. E., 1.
SWENSON, FRANK A.

1. Sedimentation near junction of Maquoketa and Mississippi Rivers. *Jour. Sedimentary Petrology*, vol. 12, no. 1, pp. 3-9, illus., Apr. 1942.

Deals with the study of sediment samples which show that the Maquoketa River has been an important factor in the deposition in the Mississippi River in a reach below the junction of the two rivers. Graphs show cubic yards of sediment dredged from the Mississippi in the area. Includes data on size-grade distribution of samples.

Discussion: GORDON RITTENHOUSE, (vol. 13, no. 1, pp. 40-42, illus., Apr. 1943), comments on the work and summarizes the pertinent data given by Swenson. Shows histograms of bed and suspended loads of the Enoree River, S. C., during a flood in August 1939. Does not believe that data from flume studies or measurements on rivers indicate the occurrence of differential movement in all or most rivers.

SWIFT, T. T.

1. Date of channel trenching in the Southwest [letter to editor]. *Science n. s.*, vol. 63, no. 1620, pp. 70-71, Jan. 15, 1926.

Letter refers to Date of Channel Trending in the Arid Southwest (Bryan, K., 4). Cites writer's observations on bank erosion, increased channel width, floods of the Gila River, and arroyo cutting on San Simon Wash as a result of overgrazing.

SWINEFORD, ADA.

1. (and Swineford, Frances). A comparison of three sieve shakers. *Jour. Sedimentary Petrology*, vol. 16, no. 1, pp. 3-13, tables, Apr. 1946.

Compares three mechanical shakers with each other and with hand shaking so as to obtain their relative efficiency. Shows that the mechanical sieve shaker which includes a jarring action is better than the two which have only a horizontal motion.

SWINEFORD, FRANCES. See Swineford, A., 1.

SWITZERLAND AMT FÜR WASSERWIRTSCHAFT.

1. Wasserführung, Sinkstofführung und Schlammablagung des Alten Rheins (Discharge, suspended matter, and silting in the Old Rhine). 49 pp. Bern, 1932. (Its Mitteilungen no. 31). In German. Partial translation on file at the U. S. Soil Conservation Service, Washington, D. C., and California Institute of Technology, Pasadena, Calif.

Deals with experiments made at the Experimental Station for Hydraulics at the Swiss Technical Institute to determine reliable bases for the construction of regulating projects on the Rhine. The purpose was to ascertain the hydraulic conditions under which the river bottom is being attacked, and the hydraulic conditions under which suspended matter is made to settle or what is the quantity of silt carried in suspension under certain runoff conditions. Describes methods of making experiments. Gives mechanical analyses of experimental muds. Gives various formulas. Comments on the transporting capacity of water due to such factors as water depth, velocity, bed roughness, and composition and concentration of silt. Considers the velocity of fall by which sedimentation takes place.

2. Untersuchungen in der Natur über Bettbildung, Geschiebe- und Schwebstofführung (Field research concerning bed formation, bed load, and suspended-load movement). 114 pp. Bern, 1939. (Its Mitteilungen no. 31). In German. Abstract in English by Paul Nemenyi on file at the U. S. Soil Conservation Service, Washington, D. C.

Outlines development of an investigation on the River Hasliaare aided by results from studies at research laboratories, and mentions the collaborators of the present work. Examines the bed-load formulas by Meyer-Peter, Favre, and Einstein. Gives a hydrographic and hydroau-

lic study of the flow. Studies the quantity, movement, and gradation curves of bed load. Deals with suspended load, and gives various conclusions.

SYKES, E. F. See Griffith, W. M., 1.

SYKES, GLENTON G.

1. Effect of berms on flow in Alamo Canal. *Engin. News-Rec.*, vol. 95, no. 11, p. 433, Sept. 10, 1925.

Discusses the effects of silt lodgement around roots of plants along the berms of the Alamo Canal (Imperial Valley, Andrade, Calif.) in building out berms and decreasing water velocity when water level rises above bottom of built-out berm. This is of interest in connection with stream gaging one mile below intake of canal.

2. Reduction in flow causes scour. *Engin. and Contract.*, vol. 64, no. 5, p. 1049, Nov. 1925.

Describes peculiar effects observed in Imperial Canal where reduction in flow causes scour. Notes that during summer months when canal carries a maximum discharge, banks cave into stream; toward end of summer when discharge is reduced and stage lowered, water recedes from standing banks causing a stoppage of "side feed." The resultant conditions are favorable to general scour. During September 1925, the entire canal scoured about 1 ft.; the scour taking place when the percentage of suspended matter was abnormally high.

SYKES, GODFREY.

1. The Delta and estuary of the Colorado River. *Geog. Rev.*, vol. 16, no. 2, pp. 232-255, illus., Apr. 1926.

Deals with the physiographic changes now taking place in the Delta region of the Colorado River. Includes discussion on the delta building forces, recent changes in alignment of the main channel, the diversion cut, secondary delta building, existing conditions in the estuary, and the probable effect of proposed flood control and water storage works upon estuary conditions.

2. The Colorado Delta. *Carnegie Inst. Wash.*, Pub. 460, 193 pp., illus., 1937.

Presents results of a study covering a period of 45 yr., 1891-1935. Deals with the history of exploration and navigation on the lower Colorado River, the physiographic developments in the Colorado Delta observed during the period of study, and the influence of works and undertakings designed for the control, protection, or diversion of the river during the past century upon the movements of the stream or the distribution of its detrital material. Includes special investigations dealing with the origin and physical characteristics of the detrital load transported by the stream, the manner of debris movement to the delta, and the effects of various influencing factors upon the distribution and deposition of detrital material. Bibliography is included.

3. Delta, estuary, and lower portion of the channel of the Colorado River, 1933 to 1935. *Carnegie Inst. Wash.*, Pub. 480, 70 pp., illus., 1937; [abstract], *Civ. Engin.*, vol. 7, no. 12, p. 12, Dec. 1937.

A study on flow, deposition, and river movement on lower Colorado River preceding and following closure of the Boulder Dam.

4. End of a great delta. *Pan-Amer. Geol.*, vol. 69, no. 4, pp. 241-248, May 1938.

Discusses the various factors inherent in the present regimen of the Colorado River. Cites evidence to support the fact that the growth and development of the Colorado Delta have terminated. Discusses the various geologic factors which have determined the extent and character of the subaerial portion of the delta. The texture and character of the detrital material delivered at the head of the gulf, actual particle size, and gradient of channel are described. Cites circumstances which have affected the development of the delta in the past 30 yr., noting channel diversion, development of great barrier deposits, and completion of Boulder Dam.

SYMONS, G. E.

1. (and Torrey, W. L.). Buffalo River stream pollution studies, 1936-1939. *Sewage Works Jour.*, vol. 12, no. 3, pp. 586-600, illus., May 1940.

- SYMONS, G. E. - Continued
Gives the results and technique of the investigation of pollution studies. Includes brief data on estimated extent of soil erosion in the drainage area of the Buffalo River based on observations of sedimentation in a dredged basin.
- SZETO, W.
1. Hydraulic problems in China. *Water and Water Engin.*, vol. 48, no. 592, pp. 439-459, illus., Aug. 1945.
Notes the silting problem of the Yellow River and other rivers in North China. States that the Delta of the Yellow River has increased in length about 10 km. a century. Considers methods used in China for prevention of silting.
- SZILAGY, JULIUS.
1. Flood control on the Tisza River. *Military Engin.*, vol. 24, no. 138, pp. 623, 626, illus., Nov./Dec. 1932.
A report on the Tisza River in Hungary, noting floods and flood control work. The silt and bed erosion of the river and of the Szamos, Bors, and Danube Rivers are described. In the upper course, the river carries only sandy gravel but below the mouth of Bors, a mixture of grit and sand appears. Downstream to the mouth of the Szamos, the sand gets finer; below which point, the suspended matter is only the finest sand and floating silt. The geology of the river bed is discussed.
- TAGGART, ARTHUR FAY.
1. Handbook of ore dressing. 1679 pp., illus. New York, John Wiley & Sons, Inc., 1927.
A book which serves as a reference handbook for engineers dealing with ore-dressing processes and a textbook for students. Gives formulas for falling bodies in a viscous fluid such as Stokes' formula. Presents the law of turbulent resistance by Newton. Includes Allen's equation for velocity of fall of spheres and the investigation of the free fall of mineral fragments in water by Richards.
- TAIT, C. E.
1. Irrigation in Imperial Valley, California. 60th Cong., 1st sess., S. Doc. 246, 56 pp., illus., 1908.
Deals with the various aspects of irrigation in the Imperial Valley, Calif. Includes brief discussion on the extent of silt deposited on Imperial Valley lands by irrigating waters of the Colorado River, also its fertilizing value.
- TALBOT, M. W. See also Watts, L. F., 1.
1. Range watering places in the Southwest. U. S. Dept. Agr., Dept. Bul. 1358, 43 pp., illus., Jan. 1926.
Presents results of a study on methods and practices of construction of range water developments in Arizona and New Mexico. Discusses the quantity, removal, and prevention of silt accumulations in small reservoirs.
- TALJAARD, M. S.
1. Treat catchments as a whole. *Veld Trust News*, vol. 5, no. 4, pp. 14-16, illus., Jan. 1949.
Discusses the use of small stream works to influence erosive behavior and to treat catchments. Notes use of ramps in the "ageing" of streams. Proposes to induce "ageing" on smaller tributaries and extend this to all streams in a drainage basin. Reports that regional "ageing" retards sheet flooding and causes the water table to rise, aiding in establishing a plant cover to retard erosion.
- TAMHANE, V. A.
1. Soil amelioration - the effect of river silt on soils. *India Bd. Agr. and Anim. Husb., Crops and Soils Wing, Proc.* (1935) 1, pp. 269-270, 1936.
Presents results of experiments conducted at the Agricultural Research Station, Sakrand, India, to determine the fertility of silt. Concludes that the beneficial effect of silt on land is due to improved physical properties of the surface layer of the soil, not to the fertility of the silt.
2. (and Iyengar, M. A. Shama). Fertility value of the silts of the Indus. *Agr. and Live-stock in India*, vol. 6, pt. 2, pp. 161-168, May 1936.
Presents results of experiments to determine the fertilizing value of the silts of the Indus at various places along the river. Data on silt content of Indus waters are given. The effects of fineness of silt particles and the depth to which it is laid down are considered. Records of crop yields are noted.
- TANNER, WILLIAM F.
1. An electrical method for the identification of sands. *Amer. Jour. Sci.*, vol. 238, no. 1, pp. 42-46, illus., Jan. 1940.
Discusses the sorting and angularity of sands as a lead to the solution of problems on method of transportation and deposition. Describes a method of determining the angularity of sands electrically. Graphic representations and formulas for the extension of various curves are given.
- TARR, RALPH S.
1. Erosive agents in the arid regions. *Amer. Nat.*, vol. 24, no. 281, pp. 455-459, May 1890.
Deals with the agents of erosion at work in the arid western plateau region of the United States. Describes the intense action of a flood in an arroyo in the Rio Grande Valley, N. Mex., due to a local cloudburst in the Donna Anna Mountains of about half an hour duration. Large quantities of material brought down from hills covered completely with silt several acres of vineyard. Some small orchards were partially buried and an adobe house about 10 ft. high was buried 8 ft. deep.
2. The Yakutat Bay region, Alaska I. Physiography and glacial geology. *U. S. Geol. Survey, Prof. Paper* 64, pp. 1-144, illus., 1909.
Includes discussion on the deposits of the Kwik River, factors affecting the water and sediment supply of the stream, changes in the distributaries that flow over the alluvial fan of the Kwik River, conditions of deposit of material carried in the stream, outward growth of the coast at the mouth of the Kwik River, and contribution to marine sediments of glacial stream deposits.
3. (and Martin, Lawrence). An effort to control a glacial stream. *Assoc. Amer. Geog., Ann.*, vol. 2, pp. 25-40, illus., 1912.
Describes the effort of controlling a glacial stream by diversion, thereby halting damage to the Alaska Northern Railway near Spencer Glacier caused by the deposition of coarse sediment and gravel.
- TARZWELL, CLARENCE M. See also Hubbs, C. L., 1.
1. Progress in lake and stream improvement. *North Amer. Wild Life Conf., Trans.*, vol. 21, pp. 119-134, 1935.
Discusses methods for maintaining and building up supply of game fish through suitable environment obtained by lake and stream improvement. The effect of silting on fish habitat noted.
- TAYLOR, COLIN A.
1. Debris flow from canyons in Los Angeles County flood. *Engin. News-Rec.*, vol. 112, no. 14, pp. 439-440, illus., Apr. 5, 1934.
Describes the character of the detritus flow which caused most of the damage in a flood ending Jan. 1, 1934. Considers damages to the towns of La Crescenta and Montrose, caused by mud flows.
2. Transportation of soil in irrigation furrows. *Agr. Engin.*, vol. 21, no. 8, pp. 307-309, illus., Aug. 1940.
Presents available information on transportation velocities and discusses the soil movement factor in connection with the design of furrow shapes and selection of grades in irrigation developments. Applies results of Gilbert's experiments to the problem of soil transportation in irrigation furrows. The effect of shape and slope to make furrows better water-conducting, and to reduce clogging difficulties is discussed. Gives data on competent mean velocities at which transportation begins for various sizes of aggregates in order to establish desirable grades for furrows.
- TAYLOR, E. H. See also Nichols, K. D., 1.
1. Velocity-distribution in open channels. *Amer. Geophys. Union, Trans.*, vol. 20, pt. 4, pp. 641-643, illus., Aug. 1939.
Presents several remarks which further attempt to adapt the momentum-transfer theory of turbulent flow, developed by Prandtl and Von Karman, to flow in open channels.
- TAYLOR, E. MCKENZIE. See also Shaw, A. M., 3.
1. Agricultural value of Nile silt held fallacious. *Engin. News-Rec.*, vol. 102, no. 25, pp. 993-995, June 20, 1929.

Briefly outlines history of irrigation in Egypt stating that land is irrigated not inundated, therefore, does not receive annual deposit of silt from Nile River and that summer cropping is substituted for summer fallow in agricultural system. On the basis of field plots, the author draws the conclusion that elimination of summer fallow rather than reduction of silt is caused of decline in soil fertility.

2. Punjab practice of silt observations. Punjab Irrig. Res. Inst., Res. Pub., vol. 2, no. 15, 13 pp., illus., Feb. 1936.

Gives diagrams showing the latest type bed silt and silt bottle samplers.

TAYLOR, G. H. See Stearns, H. T., 1.
TAYLOR, G. I.

1. The motion of a sphere in a rotating liquid. Roy. Soc. London, Proc., Ser. A, Math. and Phys. Sci., vol. 102, no. 715, pp. 180-189, illus., Nov. 1, 1922. Notes that difficulties have prevented the solution of any three-dimensional motion problem in a rotationally moving fluid. Points out that a solution can be obtained when the sphere moves steadily along the axis of rotation of a fluid. Treats the wave system in a rotating fluid and an experimental demonstration of the existence of a non-rotating sheath of fluid round a sphere moving in a rotating fluid.
2. The motion of ellipsoidal particles in a viscous fluid. Roy. Soc., London, Proc., Ser. A, Math. and Phys. Sci., vol. 103, no. 720, pp. 58-61, Apr. 3, 1923.

Describes an experimental investigation of the motion of ellipsoidal particles in a viscous fluid undertaken to test an unproved hypothesis introduced by G. B. Jeffery in a paper entitled The Motion of Ellipsoidal Particles Immersed in a Viscous Fluid (Jeffery, G. B., 1). This hypothesis states that ellipsoidal particles immersed in a moving viscous fluid will assume certain definite orientations in relation to the motion of the fluid.

3. Effect of variation in density on the stability of superposed streams of fluid. Roy. Soc., London, Proc., Ser. A, Math. and Phys. Sci., vol. 132, no. 820, pp. 499-523, illus., Aug. 1, 1931. A mathematical treatment of the effect of density variation on the stability of superposed streams of fluid.

TAYLOR, G. L.

1. A centrifuge tube for heavy mineral separations. Jour. Sedimentary Petrology, vol. 3, no. 1, pp. 45-46, illus., Apr. 1933.

Describes an inexpensive and permanent centrifuge tube for the making of rapid and efficient separation of grains less than one-half mm. in diameter.

TAYLOR, J. R., JR. See Troug, E., 1.

TAYLOR, RALPH E. See Russell, R. D., 3, 5.

TAYLOR, ROBERT S.

1. An emergency in the life of a river. Prof. Mem., vol. 2, no. 5, pp. 82-98, illus., Jan./Mar. 1910. Discusses the use of brush-matress and stone riprap revetment on the banks of the Mississippi River. Describes localities where revetments have been built or are needed.

TAYLOR, THOMAS U. See also Hemphill, R. G., 2.

1. The Austin Dam. U. S. Geol. Survey, Water Supply and Irrig. Papers 40, 52 pp., illus., 1900; also in Tex. Univ. Bul., Sci. Ser. 16, 85 pp., illus., Dec. 22, 1910. Discusses causes of failure of Austin Dam on Colorado River in 1900. Describes silting of Lake McDonald from 1890 to 1900. During May 1893, main channel was filled to crest of dam with 83,556,000 cu. yd. of water, and in 1897 this space was filled with 31,667,000 cu. yd. of silt and 51,889,000 cu. yd. of water. Average rate of silt deposits was 5.8 ft. per yr. up to February 1900. The silt in lower part of the lake was very fine grained and was readily carried away by water after break in the dam. A formula for the rate of silting of reservoirs is given.
2. The silting-up of Lake McDonald and the leak at the Austin Dam. Engin. News, vol. 43, no. 8, pp. 135-136, illus., Feb. 22, 1900; [abstract], Science n. s., vol. 11, no. 273, pp. 469-470, Mar. 23, 1900.

Describes the silting-up of Lake McDonald (Lake Austin) and the leak at Austin Dam. Discusses surveys of 1890, 1897, and 1900, noting that in 1897 silt in reservoir amounted to 38 percent of the original capacity; an annual deposit of 7.7 ft. on a sq. mile base. A table is given showing maximum and mean depths of water in reservoir for 1893 and 1900, maximum and mean depths of silt for 1900 and the percentage of silting at respective stations. In 1900, silt in reservoir amounted to 48 percent of original storage capacity; a deposit rate of 5.8 ft. per sq. mile per yr. Outlines the character of silt in various portions of reservoirs. Describes theory of silting-up of Lake McDonald reduced to heights or depths per square mile base. Presents curve illustrating progress of silting up in Lake McDonald, and describes leak in Austin Dam.

3. More light on the failure of the Austin Dam. Engin. News, vol. 43, no. 19, pp. 308-309, illus., May 10, 1900.

Gives possible reasons for the failure of Austin Dam. Includes one paragraph noting that silt behind dam was not a cause of the dam's failure. Gives surface characteristics of silt remaining in reservoir after failure.

4. Reservoir loses 84 percent of storage capacity in nine years. Engin. News-Rec., vol. 91, no. 10, pp. 380-382, illus., Sept. 6, 1923.

Describes the floods of the Colorado River in Texas, particularly at Austin and Webberville, Tex., during the years 1843, 1852, 1869, 1870, 1900, and 1918. Silting of both the old and the new Lake Austin, and failure of the old Lake Austin Dam are discussed. Silt survey results of new lake in 1913 and 1922 are tabulated for 11 cross sections, showing a loss of capacity of 83.84 percent during the 9 yr. from 1913 to 1922.

5. Silting of the lake at Austin, Texas. Tex. Univ. Bul. 2439, 23 pp., illus., Oct. 15, 1924.

Discusses silting of Lake Austin on the Colorado River at Austin, Tex. Describes the lake (1924), old Austin Dam, and the location of survey stations. Tables show maximum and mean depths of silt for 1900, and percentage of silting at various stations. Notes that in 1900, after 6.75 yr. of operation, depth of water in the lake was 40.22 ft. and of silt 37.01 ft., a decrease in capacity of 48 percent. Cross-sectional diagrams show silt in the lake at various points. Discusses the effect of increased height of water above crest of dam on scouring at some sections and deposition of a sandbar at another, Apr. 7-June 2, 1899. Silting of reservoirs is reduced to heights or depths on a square-mile base (formula, table and graph); results are not true for a reservoir in which an appreciable current is acting on the upper surface of the silt. New Austin Dam was completed in 1913. Resurveys in 1913, 1922 and 1924 showed a decrease in original capacity of 32,025 acre-feet in 1913 to 5,362 acre-feet in 1922 and 2,901 acre-feet in 1924, a loss of 90.94 percent of its capacity in 11 yr. which is equal to an average annual deposit of 19.69 percent. Cross-sectional diagrams show silt in the new lake (1924) at various points. Discusses historic floods on the Colorado River at Austin, Tex., and on the Colorado and Brazos in 1869, 1870, 1900, and 1913.

6. Silting of the lake at Austin, Texas. Amer. Soc. Civ. Engin., Trans., vol. 93, pp. 1681-1689, illus., 1929; also in Amer. Soc. Civ. Engin., Proc., vol. 54, no. 2, pp. 569-577, illus., Feb. 1928.

Considers the silting of Lake Austin on the Colorado River at Austin, Tex. Describes old Lake Austin, noting that in 1900, after 6.75 yr. of operation, the capacity of the lake was only 52 percent of the capacity in May 1893. Tables show maximum and mean depths of water for 1893 and 1900, maximum and mean depths of silt for 1900, and percentage of silting at respective stations. Cross-sectional diagrams show silt in old and new Lake Austin at various stations. Discusses the effect of the increased height of water above the crest of the dam on scouring at some sections and deposition of a

sand bar at another (Apr. 21-June 2, 1899). Resurveys in 1913 after completion of the new dam and in 1922, 1924, and 1926 showed a decreased in water volume from 32,025 acre-feet in 1913 to 1,477 acre-feet in 1926; thus in 13 yr. the Austin Lake silted 95.39 percent of its volume. Notes accumulations of drift in Lake Austin.

Discussion: L. M. LAWSON, p. 1690, describes the Rio Grande and the Elephant Butte Reservoir located on it. Total river discharge into the Elephant Butte Reservoir, as measured at San Marcial, November 1916-August 1925, was 10,840,500 acre-feet; total silt deposited for the same period was 177,740 acre-feet; percentage of deposited silt to water is 1.6; and the average annual deposit for the period is 20,470 acre-feet. C. H. EIFFERT, pp. 1690-1691, describes the retarding basins of the Miami Conservancy District in which the rate of silting is reputed to be very small. The manner of silting, use of land included in basins for agricultural purposes since deposited silt is of great value as fertilizer, variations in amount of silt carried, and removal of silt deposited by backwater are described. Describes construction and use of silt-catching boxes to obtain measurements of the actual amount of silt deposited by individual floods and the amount remaining in reservoirs and to obtain silt samples for analysis to determine its value as fertilizer. OREN REED, pp. 1691-1692, describes the Colorado River of Texas, noting that its silt burden has been roughly estimated at 1 percent of its volume. Outlines the value of forests on the watershed, the use of check dams or settling basins and headwater streams, and stream bank protective measures to prevent erosion and subsequent silting of reservoirs. CHARLES SCHULTZ, pp. 1692-1693, states that the small reservoir formed by a dam designed by the author at McKinney, Tex. became completely silted in 10 yr. Describes the silting to 4 ft. in depth, adjacent to the bank of the levee constructed along Pilot Creek, tributary to Trinity River. JOHN B. HAWLEY, pp. 1693-1695, describes areal geology, mean annual rainfall, and silting per square mile of the drainage areas of Austin, Worth, and Medina Lakes. Examination of cross-sections of old Austin Lake indicates that it merely offers a large channel section for carrying storm waters, the velocity of which would probably be sufficient to carry a large proportion of fine silt over the dam. Examination of cross-sections of new Lake Austin shows that current velocities in times of flood are ample to transport all but the largest and heaviest silt particles over the spillway. Notes conditions of silting of three channel dams on the Clear Fork of Trinity River. The first flood, after completion of these dams, left about 18 in. of silt deposit at each dam; a subsequent flood carried out silt left by its predecessor and made new deposits so that after 27 yr. there is no more silt behind the dams than was left after the first flood. H. F. ROBINSON, pp. 1695-1702, notes depletion in reservoir capacity at Austin of 95.39 percent in 13 yr., and at Zuni Reservoir of 94.89 percent in 22 yr. The theory of silting of reservoirs as advanced by T. U. Taylor does not fit conditions found by the author's experience at Zuni Reservoir. Gives tables and graphs of silt deposits in Zuni Reservoir, indicating an irregular deposit which has no reference to capacity of the reservoir and only indirectly to quantity of water, with silt content being almost undetermined. Discusses the relationship between silt deposited in reservoirs and runoff. Describes methods of prevention of erosion on tributaries by rock and brush checks and jetty construction. Studies of tributaries were made to find critical places in need of such protection. Describes processes of erosion, noting the distinction between normal and abnormal erosion, and discusses the influence of such factors as vegetation, climate, and overgrazing. JULIAN MONT-

GOMERY, p. 1703, points out factors to be considered in the design of storage reservoirs, noting that 0.3-0.5 acre-feet per sq. mile of drainage area should be allowed for silt storage in designing storage reservoirs in the Southwest. Also points out that Lake Wichita near Wichita Falls, Tex., shows very little silting in 25 yr., with a probable average net deposit over the entire reservoir area of less than 1 ft. even though there is considerable silt in the runoff. Gives the relation of the drainage area to storage capacity of old Lake Austin, Lake Wichita, and Lake Kemp. KIRK BRYAN, pp. 1703-1707, notes the process of erosion and deposition characteristic of streams in the arid Southwest. Gives a theory of conditions of erosion and sedimentation on watersheds of ephemeral streams to determine the cause of accelerated erosion or arroyo cutting. Experience in the operation of Zuni Reservoir, N. Mex. on the ephemeral Zuni River gives qualitative evidence to support the theory. Describes observations at Zuni Reservoir to show the relation between runoff and silt content of water entering the reservoir, noting in conclusion that the greater the runoff the less silt in the water. A similar analysis by W. W. Follette, applied to silt determinations on the perennial Rio Grande at San Marcial, shows no relation between discharge and silt content; analysis of data on silt at and near San Carlos on the Gila River shows a curve on the relation of discharge to silt content, somewhat similar to that of the Zuni River since the Gila at this point is intermittent or even ephemeral. Gives, as causes of accelerated erosion, the lack of vegetative cover, overgrazing, and change to a dryer climate. Notes that successful control of silt depends on the restriction of grazing, the introduction of drought-resistant plants on the watershed, and the construction of retarding and retaining works on streams. J. C. STEVENS, p. 1707, notes economic losses involved in the silting of reservoirs. P. A. WELTY, pp. 1708-1713, notes the effects of silt on canal operation in the lower Rio Grande Valley of Texas on the San Benito project. BANKS MCLAURIN, pp. 1713-1715, notes that Austin Lake is not a channel reservoir and that the valley part of the lake silted more rapidly than the channel part. Discusses the silting of Lake Penick, a channel reservoir on the Clear Fork of the Brazos River at Lueders, Tex. Observations made in 1927 indicate that the lake has silted 31.2 percent of its original volume in the 7 yr. following its completion. Gives illustrations of silting at 18 cross-sections of Lake Penick and a profile of the lake bottom. R. G. TYLER, pp. 1715-1717, gives a table of silt content at specific points of the Brazos, Missouri, Arkansas, Colorado, Tennessee, Yadkin, Mississippi, Susquehanna, and Hudson Rivers, noting the extreme variations in the amount of silt carried (U. S. Dept. Agr. Bul. 1430). Comments on the character of a drainage area as an important factor with reference to its silt production. Offers variations in the annual rate of deposition at Austin Lake, noting that an even greater proportion of silt is carried over the dam each year because of a decrease of the detention period in the lake and the corresponding velocity increase of water flowing through. Points out the gradation of material deposited in the valley downstream from the Austin Dam. Outlines briefly the necessity of silt control to protect reservoirs against silting, and indicates that an upper reservoir constructed with a bypass around the lower or main reservoir would operate as a hegemonical factor. P. A. BANTEL, pp. 1717-1719, gives a table showing the quantity of silt and rate of silting for old Lake Austin, new Lake Austin, McKinney Reservoir, Lake Penick, Lake Worth, Elephant Butte Reservoir, Zuni Reservoir, and McMillan Reservoir. Gives a comparison of the effect of accumulated silt on the subsequent rate of silting for Lake Austin, and Zuni, Elephant Butte, and McKinney Reservoirs. Notes a method of preventing reservoir silting by the

use of undersluices in dams through which silt-laden flood waters may be passed, the rate of silting of reservoirs, and the present water shortage in Texas. R. F. WALTER, pp. 1719-1728, considers the relation between the storage capacity of Lake Austin and the annual flow of the Colorado River of Texas, noting that the reservoir could not operate efficiently as a desilting agency and undoubtedly large quantities of silt have been carried over the dam during floods. Notes the work of the U. S. Bureau of Reclamation on the problem of storage depletion of reservoirs by silt accumulations on irrigation projects in southwestern parts of the United States. Presents the results of silt surveys made at McMillan (1904, 1910, 1915, and 1925) and Elephant Butte (1916, 1920, and 1925) Reservoirs. Summarizes data on silt deposited in Lake McMillan, also average rates of silt accumulation. Points out the reduction in rate of silting from 1,930 acre-feet per yr. (January 1894-June 1915) to 350 acre-feet per yr. (June 1915-June 1925) due to a dense and extensive growth of tamarisk at the upper end of Lake McMillan which caused a spreading of the river flow above the reservoir, resulting in velocity reductions and silt deposition, thus keeping larger portions of silt from entering the lake. Offers summarized evidence concerning silt accumulation at Elephant Butte Reservoir, annual rate of deposit, and the effect of silting on the capacity of reservoirs. Estimates that the total life of Elephant Butte Reservoir will be 114 yr. WILLIAM JENNER POWELL, pp. 1728-1731, notes the loss of 95 percent of the water capacity of Lake Austin in 13 yr. due to silting. Describes silt surveys of White Rock Reservoir, Tex., during 1923 and 1938. Gives distribution of silt in various sections of the reservoir and total amount of silt in the lake. Describes White Rock watershed and notes that silt carried by the stream in flood is coarse and heavy and deposits quickly on retardation. This fact and the excellent retarding basin formed by the growth at the head of the lake practically prevents silting in the main body of the lake. R. I. MEEKER, pp. 1731-1733, notes the loss of 220,000 acre-feet of storage capacity due to silting of the Elephant Butte Reservoir on the Rio Grande. Reports that at Roosevelt Reservoir, which had an original capacity of 1,367,000 acre-feet, a silt deposition amounting to 101,000 acre-feet was reported for the 20-yr. period ending in 1925. Describes briefly watershed conditions of the Castlewood and Buckhorn Reservoirs in Colorado, noting that the capacity of Castlewood Reservoir was greatly reduced following 38 yr. of operation and that the capacity of Buckhorn Reservoir was diminished to practically one-half its original capacity in 18 yr. as a result of silting. Calls attention to the rise of the river bed of the Rio Grande near San Marcial, N. Mex., and that of the Arkansas River in western Kansas amounting to 12 ft. and 5 ft., respectively, in 45 yr. Discusses the need for study of the erosion problem and means for its control. Gives a table of the amount of silt deposition in Elephant Butte, Roosevelt, Austin, McMillan, Zuni, Castlewood, and Buckhorn Reservoirs in the southwestern United States. THE AUTHOR, pp. 1733-1735, notes that no relationship exists between runoff and amount of silt deposited in reservoirs. Discusses the comparative silting of channel reservoirs and those whose lakes spread over their banks and have widths equal to many times that of the river channel. A survey shows that silting in Lake Worth, Tex., amounted to 13,837 acre-feet in 13 yr. reducing the capacity to 70.67 percent of the original capacity. Estimates the reduction to 49.95 percent of the original capacity by 1941. Notes the ever-present menace to the San Benito project of silt from the Rio Grande.

7. Silting of reservoirs. Tex. Univ., Bul. 3025, 170 pp., illus., July 1, 1930.
Deals with the silting of various reservoirs, canals, streams, etc. Considers such subjects

as types of silt, weight of deposited silt, watershed conditions, kinds of reservoirs, and silt survey methods. Considers the effect on sedimentation in reservoirs of the amount and rate of rainfall, runoff, vegetation, and cycles of wet and dry years. Gives silting data on Old Lake Austin, Tex., New Lake Austin, Tex., Lake McMillan, N. Mex., Zuni Reservoir, N. Mex., Elephant Butte Reservoir, N. Mex., Lake Worth, Tex., White Rock and Boysen Reservoirs, Wyo., Lake Penick, Tex., Parkerville Dam (Ocoee No. 1, Tenn.), Keokuk Reservoir, Iowa, Lake Wichita, Tex., Medina Lake, Tex., Lake Kemp, Tex., Lugert Reservoir, Okla., and Lake Dallas, Tex. Treats of silting in the Rio Grande Valley, the Colorado River Basin, the Mississippi River Basin, and the Des Moines Canal. Deals with the desilting of reservoirs and canals, noting self-scouring reservoirs, dredging, settling basins, cost of canal cleaning, scouring of Lake Austin, bank raising, skimming weirs, Ruth machine, Ving, desilting Ocoee flume, and ebb desilting.

TAYLOR, W. D.

1. The effect on meadow lands of back water from dams [letter to editor]. Engin. News, vol. 48, no. 16, p. 316, illus., Oct. 16, 1902.

Letter to editor in reference to inquiry on the effect of backwater from a dam on meadow lands (Engin. News, Sept. 11, 1902). Cites case of spoiled underdrainage on a farm, probably due to general rise of river level and filling in of various natural and artificial channels resulting from stream obstruction by a dam.

TCHEN, CHAN-MOU.

1. Mean value and correlation problems connected with the motion of small particles suspended in a turbulent fluid. Delft. Technische Hoogeschool, Lab. voor Aero- en Hydrodynamica, Medede. 51, 125 pp., illus., 1947.

A study to elucidate problems concerned with the diffusion of irregularly moving particles as when particles are suspended in a fluid in turbulent motion. Considers the general theory of dispersion phenomena. Treats certain probability functions, referring to the displacements of particles or to their velocities, and bases the investigation principally on the method developed by Kolmogoroff. Investigates diffusion phenomena by means of dispersion functions. Treats of the relation of the motion of a single particle and the surrounding fluid using an equation derived by Basset, Boussinesq, and Oseen, which is an extension of Stokes' resistance formula. Applies results obtained to the derivation of the equation governing the diffusion of particles.

TCHIKOFF, C. C. See Kramer, H., 2.

TCHIKOFF, V. V. See Lane, E. W., 4; Vogel, H. D., 8.

TENNESSEE STATE PLANNING COMMISSION.

1. The Obion River and Forked Deer River watersheds. 17 pp., illus. Nashville, Tenn., 1936.

Report deals with drainage enterprises and land conditions within the Obion River and Forked Deer River watersheds in West Tennessee, showing necessity for securing adequate information and data, and suggesting method of undertaking a program to improve conditions in this section. Contains illustrations of clogged conditions in the South Forked Deer River due to silting, and notes effect of silting on plant life in farm and forest areas in the regions considered.

TENNESSEE VALLEY AUTHORITY. See U. S. Tennessee Valley Authority.

TERZAGHI, CHARLES.

1. Principles of soil mechanics IV. Settlement and consolidation of clay. Engin. News-Rec., vol. 95, no. 22, pp. 874-878, illus., Nov. 26, 1925.

Discusses factors related to the natural settlement of mud deposits. Outlines theory of hydrodynamic stress in the settlement and consolidation of clay.

TESTER, ALLEN C.

1. The measurement of shapes of rock particles. Jour. Sedimentary Petrology, vol. 1, no. 1, pp. 3-11, illus., May 1931.

Discusses the value of shape analysis of rock particles. Proposes a new method which is

TESTER, ALLEN C. - Continued

based on the ratio of the length of the original surface to the portion worn away. Suggests technique for measurement of various grain sizes.

2. (and Bay, H. X.). The shapometer; a device for measuring the shapes of pebbles. *Science n. s.*, vol. 73, no. 1899, pp. 565-566, illus., May 22, 1931.
Describes and gives method of use of the "shapometer," an instrument for measuring shapes of pebbles.
3. [Review of] The mechanical composition of sediments in graphic form, by Chester K. Wentworth. *Iowa Univ., Studies in Nat. Hist.*, vol. 14, no. 3, 127 pp., illus., 1932; also in *Jour. Sedimentary Petrology*, vol. 2, no. 2, pp. 128-130, Aug. 1932.
Describes the paper and makes various comments concerning the mechanical composition of sediments in graphic form. States that the paper should be used with caution. Various factors concerned with the subject are considered.
4. [Review of] Treatise on sedimentation, by W. H. Twenhofel. *Jour. Sedimentary Petrology*, vol. 3, no. 1, pp. 47-48, Apr. 1933.
Comments on the new edition of the Treatise on Sedimentation by Twenhofel. Notes the subject matter and various improvements over the older edition.
5. [Review of] On the mineralogy of sedimentary rocks, by P. G. H. Boswell. *Jour. Sedimentary Petrology*, vol. 4, no. 1, pp. 50-51, Apr. 1944.
Comments on the book written by Boswell, and summarizes the contents of the various chapters. Considers the following: stability of detrital minerals; minerals as clues to source of sediments; correlation by means of minerals; detrital minerals; and mineral composition of clays. Notes that the report contains a bibliography with abstracts of over 1000 articles dealing with the mineral constituents of sediments.

TEXAS BOARD OF WATER ENGINEERS.

1. Sixth report...covering the two year period from September 1, 1922 to August 31, 1924, inclusive. 53 pp. Austin, 1925.
Discusses briefly the problem of silting in proposed reservoirs in the State. Methods and procedure of silt sampling in the Brazos River are described.
2. Seventh report...covering the two year period from September 1, 1924 to August 31, 1926, inclusive. 41 pp. Austin, 1927.
Progress of silt investigations are described, and data are given on silt in the Brazos River, at Waco, Tex., October 1924 to September 1925. Silt survey of September and October, 1925 indicated that total deposit in Medina Lake amounted to 2692 acre-feet or 207 acre-feet per annum. Reconnaissance survey of Lake Worth indicated silting at the rate of 1000 acre-feet per annum. Character and distribution of deposits in Medina Lake, Lake Worth, and Lake Kemp are noted. Observations of silt underflow at Medina Lake in April 1926 are briefly described. Data are given on volume-weight determinations of deposited silt. Results of sieve analyses of silt samples taken from the Brazos River are summarized.
3. Eighth report...covering the two year period from September 1, 1926 to August 31, 1928, inclusive. 48 pp. Austin, 1929.
Reports progress of silt investigations in the Brazos River basin. Silt sampling procedure, and method of laboratory analysis to determine silt content of samples, to ascertain the volume-weight relationship of deposited silt, and to determine the proportion of particles of different sizes in samples are described. Progress of investigations relative to the measurement of deposits of silt in reservoirs, and procedure at Medina Lake are reported.
4. Ninth report...covering the two year period from September 1, 1928 to August 31, 1930, inclusive. 48 pp. Austin, 1931.
Progress of silt measurements on Texas streams is briefly described. Stresses importance of silt studies in relation to the reservoir silting problem; notes almost complete loss of storage capacity of Austin Lake in 11 yr due to silting. Estimates the life of Medina Lake at 1600 yr.
5. Brief report of cooperative irrigation investigations, September 1, 1930 to August 31, 1932. *Tex. Bd. Water Engin., Rpt. (1930-32)* 10, pp. 38-42, 1933.
A report of irrigation investigations by the Board of Water Engineers in cooperation with the Bureau of Agricultural Engineering, U. S. Dept. of Agriculture. Results of silt investigations, June 1924-December 1930, indicate that average annual suspended load in tons for square mile of drainage area in representative streams of Texas varies from 46 for the Nueces River, near Three Rivers, to 3,326 for the Double Mountain Fork of the Brazos River, near Aspermont. Volume-weight determinations of deposited silt indicate variations in pounds per cubic foot of deposit from 18.7 to 106.1, for samples taken above Lake Worth Dam and from Medina Reservoir respectively. Increased average weight of dry material per cubic foot of deposit in Medina Reservoir is due to dewatering and accompanying shrinkage for the 5 yr. period ending October 1930.
6. Report of investigations made cooperatively with the Bureau of Agricultural Engineering, U. S. Department of Agriculture, September 1, 1932-August 31, 1934. *Tex. Bd. Water Engin., Rpt. (1932-34)* 11, pp. 25-29, 1935.
Reports progress of silt investigations relative to the amounts of silt carried by various streams of Texas and the manner and conditions of silt deposition in existing reservoirs.
7. Report of investigations made cooperatively with the Bureau of Agricultural Engineering, U. S. Department of Agriculture. *Tex. Bd. Water Engin., Rpt. (1934-36)* 12, pp. 50-55, 1936.
Reports progress of investigations, begun in June 1924, to determine the amount of silt carried by Texas streams and from which the length of life of proposed reservoirs may be estimated. Data are given on the average amount of silt carried in suspension in some of the representative river basins of the State.
8. Report of investigations made cooperatively with the Bureau of Agricultural Engineering, U. S. Department of Agriculture. *Tex. Bd. Water Engin., Rpt. (1936-38)* 13, pp. 40-50, 1939.
Reports progress of investigations, begun in June 1924, to determine the amount of silt carried by Texas streams from which the length of life of proposed reservoirs may be estimated. Table showing variations of annual silt load of Texas streams is given. Notes that if present rate of silt flow into Buchanan Reservoir is maintained and all the silt should remain in the reservoir, it would fill in 240 yr.
9. (and U. S. Dept. of Agriculture). The silt load of Texas streams—progress report as of September 30, 1939. 99 pp., illus. Austin, 1940.
Presents a compilation of results of silt investigations, begun in 1924 and carried on continuously to the present time, relative to the determination of the amounts of suspended silt carried in Texas streams, and the manner and conditions of its deposition in reservoirs. Method and procedure of investigations, sampling equipment, method of sampling, and volume-weight relationship of deposited silt are described. Data on suspended silt determinations for streams in the Upper Red, Sabine, Neches, Trinity, Brazos, Colorado (of Texas), Guadalupe, Nueces, and lower Rio Grande (below Pecos River) River basins and the Western Gulf Basin are given.
10. Progress report, 1942. 58 pp., illus., tables. Austin, 1943.
Summarizes the work of the Texas Board of Water Engineers which deals with surface water, groundwater, quality of water, duty measurement, and silt studies. Gives data for silt measurements at the following streams: Sabine, Neches, West Fork San Jacinto, Brazos, Colorado, Nueces, and Rio Grande. Includes a table giving a summary of silt data obtained from 10 active stations in Texas from 1924 to Sept. 30, 1941. A comparison is shown of data

- for the stations previous to Sept. 30, 1939, and for two additional years to Sept. 30, 1941.
11. Progress report for the period September 1, 1942-August 31, 1944. 73 pp., illus., tables. Austin, 1944. Summarizes the work concerned with surface water, groundwater, quality of water, and irrigation investigations. Contains a table which gives a brief summary of silt data obtained from all silt stations in Texas as of Sept. 30, 1943.
 12. Progress report for the period September 1, 1944-August 31, 1946. 91 pp., illus., tables. Austin, 1946. Gives results of work pertaining to water resources, surface water, groundwater, quality of water, silt, duty of water, and evaporation determinations. Includes a table showing the amount of silt carried by Texas streams. Discusses the problem of silt determinations in Texas. Notes that the amount of suspended silt load carried by Texas streams into the Gulf of Mexico averages more than 65,000 acre-feet or approximately 99,000,000 tons.
 13. Progress report for the period September 1, 1946-August 31, 1948. 209 pp., illus., tables and graphs. Austin, 1948. Gives the major facts concerning the water resources of Texas, and points out problems that need investigation. Considers surface water, groundwater, quality of water, silt, irrigation, evaporation, and drainage. Section V, pp. 144-152, deals with silt studies. Purposes and procedures of cooperative investigations of the suspended silt load of Texas streams are given. Summary of silt records for major streams of Texas is included. Map showing silt observation stations in Texas is included. Mentions survey of sediment in Medina Reservoir, and proposes a program for future studies.
- TEXAS PLANNING BOARD.**
1. Development of Texas rivers; a water plan for Texas. 156 pp., illus. Austin, 1938. Deals with existing conditions, and proposes improvements to navigation, irrigation, flood control, and other water supply developments in the stream basins of Texas. Notes the principal problems of the Trinity and San Jacinto Basins, especially the silting problem. States that Lake Waco in the Brazos River has silted 19.78 percent of its capacity in 6 yr. and that the small Austin Reservoir on the Colorado River has nearly silted full.
- THACKWELL, H. L.**
1. Protection of river banks with spur dikes [letter to editor]. *Engin. News-Rec.*, vol. 87, no. 2, p. 79, illus., July 14, 1921. Letter regarding the use of spur dikes or groynes for river-bank protection to avoid inundations from Indian rivers which have a tendency to shift courses and raise beds by deposits of silt. Describes function and methods of construction of groynes to stop erosion and promote silting.
- THIEL, GEORGE A.** See also Dreveskracht, L. R., 1; Hellman, N. N., 2.
1. The relative resistance to abrasion of mineral grains of sand size. *Jour. Sedimentary Petrology*, vol. 10, no. 3, pp. 103-124, illus., Dec. 1940. Presents photomicrographs which show the relative resistance to abrasion of mineral grains of sand size in running water. A steel drum was used as a mineral abrasion machine. Describes procedure used and gives results of tests.
- THIELSCH, HELMUT.**
1. Effect of sonic vibrations on settling rates of ground rock particles in water. *Amer. Inst. Mining and Metall. Engin. Tech. Pub.* 1999, 6 pp., Feb. 1946. Describes experiments in the Allis-Chalmers laboratory in examining the effect of sonic vibrations on settling of particles of different concentrations and sizes. Describes the sedimentation apparatus and procedure used. Deals with sonic-thickening tests of a frequency of 60 cycles. Notes need to increase coagulation in order to acquire faster settling rates.
- THOMAS, A. R.** See also Inglis, C. C., 9-21.
1. The flow and resistance to flow of water. *Indian Engin.*, vol. 104, no. 4, pp. 124-127, Oct. 1938. Presents a qualitative picture of the flow and resistance to flow of water. Flow of water is divided into four main types. Suspended particles are discussed.
2. Note on the Anderson-Einstein suspended-load sampler, with suggested modifications. 13 pp. Simla, India, Cent. Bd. Irrig., 1942. Discusses the advantages and disadvantages of the Anderson-Einstein suspended-load sampler. Describes modifications to overcome the disadvantages and presents a modified design. Considers methods of sampling.
 3. The mechanics of flow in uniform erodible channels. A qualitative review. *India Cent. Bd. Irrig.*, Pub. 29, pp. 82-90, illus., 1943. Describes the mechanics of turbulence, scour and accretion qualitatively, and their effect on the stability of channels in relation to boundary, bed and suspended load, depth, width, shape, and slope. Lacey's coefficients are discussed and reasons are advanced for deviations. Purpose of the paper is to assist the investigator and general reader in research investigation.
 4. The sampling of bed and suspended material in river and canals. *India Cent. Bd. Irrig. Pub.* 29, pp. 103-113, illus., 1943. Consists mainly of summaries and extracts from the publication *A Study in Methods Used in Measurement and Analysis of Sediment Loads in Streams*, issued by the St. Paul Engineer District Sub-Office, Hydraulic Laboratory, University of Iowa. Includes additional notes which take up samplers and practice in India and remarks by the compiler. The sampling of suspended sediment and the sampling of bed load and bed material are taken into consideration.
 5. The characteristic size-distribution parameters of transported sediment. *India Cent. Bd. Irrig. Pub.* 31, pp. 67-70, illus., 1944. Examines the processes of sediment transport, scour, and deposition. Shows significant results obtained by the use of terminal velocity of fall rather than diameter of particle and should be based on an arithmetic rather than a logarithmic scale. Comments on limitations.
 6. The Lane-Kalinske method of determining suspended load [abstract]. *India Cent. Bd. Irrig. Pub.* 31, p. 84, 1944. Gives practical details of a method for determining the total suspended load of a uniform channel from single samples on a small number of verticals. It is possible to calculate the distribution, or total load, on a vertical from an equation if the theory of turbulent mixing is accepted as applying to the distribution of suspended sediment.
 7. Methods used in measurement and analysis of sediment load in streams. *India Cent. Bd. Irrig. Pub.* 31, pp. 77-84, 1944. Gives summaries of Reports No. 3, 4, and 5 of a series of the St. Paul Hydraulic Laboratory, Iowa, U. S. A., entitled "A Study of Methods Used in Measurement and Analysis of Sediment Load in Streams" (U. S. Interdepartmental Committee, 3, 4, 5).
 8. The transport of shingle in tunnels. *India Cent. Bd. Irrig. Pub.* 31, pp. 96-99, illus., 1944. Gives a method for the design of rectangular tunnels to transport shingle or gravel by flowing water based on empirical formulas. Provides a diagram for the calculation of the position of the plane of maximum velocity and formulas derived for the calculation of energy, slope, and discharge. Effect of roughening of the top and sides is discussed.
- THOMAS, B. F.**
1. (and Watt, D. A.). *The improvement of rivers.* Ed. 2, 749 pp., illus. New York, John Wiley and Sons, 1918. This report is a treatise on the methods employed for improving streams for open navigation and for navigation by means of locks and dams. Consists of two parts: 1, Improvement for Navigation, and 2, Improvement by Locks and Dams. Considers the transportation of sediment, relation of sediment to cross section and slope, formation of bed, sand waves, scour, bed material, dredging, silting of channels, bank protection, silt in reservoirs, silting-up of pools, etc.

THOMAS, C. W.

1. California stream pollution. *Amer. Wildlife*, vol. 29, no. 5, pp. 245-247, illus., Sept./Oct. 1940.

Presents results of investigations relative to the source of and means of preventing debris deposition resulting from hydraulic mining operations, in the navigable portions of streams in California.

THOMAS, CHARLES W. See also Fry, A. S., 2.

1. Supersonic methods short-cut reservoir silt measurements. *Civ. Engin.*, vol. 19, no. 5, pp. 323-327, illus., May 1949.

Based on a paper given at the Hydraulic Division of the A. S. C. E. meeting in Oklahoma City, Okla., during April 1949. Describes conventional silt-survey equipment and procedures. Treats of the use of electronic equipment such as Shoran, radar, Raydist, and Lorac. Notes that a silt survey is being conducted on Lake Mead and the fact that 2,000,000,000 tons of sediment have been so far deposited in the lake, with the Colorado River depositing 400,000 tons per day. Comments on the use of echo-sounding equipment by the U. S. Bureau of Reclamation and challenges engineers to develop supersonic sounding equipment which will measure the depth of silt directly and to examine the behavior of density currents.

THOMAS, D. G. See Fuertes, J. H., 1.

THOMAS, FRANKLIN. See Pyle, F. D., 1.

THOMAS, MOYER D. See also Jennings, D. S., 1.

1. Replaceable bases and the dispersion of soil in mechanical analysis. *Soil Sci.*, vol. 25, no. 6, pp. 419-427, illus., June 1928.

Shows the influence of different replaceable bases on soil dispersion. Treats of the dispersion of soils.

THOMPSON, G. T.

1. Investigation of rainfall and runoff. *Commonwealth Engin.*, vol. 27, no. 5, pp. 170-172, illus., Dec. 1, 1939.

Presents data on rainfall and runoff on the Coliban River watershed, Australia. Includes a brief description of conditions of erosion in the Coliban catchment, noting that should these conditions persist and become extended the rates of siltation in storage reservoirs will increase progressively.

THOMPSON, G. W.

1. The classification of fine particles according to size. *Amer. Soc. Testing Mater., Proc.*, vol. 10, pp. 601-614, illus., 1910.

Discusses the classification of fine particles according to size, and describes an apparatus which does this practically and effectively.

THOMPSON, HUSTON.

1. The law says yes. *Land*, vol. 1, no. 3, pp. 198-202, Summer 1941.

Discusses a portion of the decision handed down by the U. S. Supreme Court in the case of the United States of America v. Appalachian Electric Power Co. which states that the Government is empowered to subject a watershed of a river system to national planning and control. Includes a discussion on causes and conditions of erosion and on conditions of silting in streams and reservoirs in the New River watershed.

THOMPSON, PAUL W. See also Kramer, H., 2; Vogel, H. D., 3, 8.

1. The technique of hydraulic model experimentation. *La. Engin. Soc., Proc.*, vol. 18, no. 4, pp. 125-134, Aug. 1932.

Considers the laws of similitude on which the science of hydraulic model research has been based. Includes discussion on the two conditions which satisfy dynamic similitude, namely similarity of flow characteristics and similarity of bed-load movement.

2. Hydraulic traction - its causes and effects. 57 pp. Vicksburg, Miss., U. S. Waterways Expt. Sta., 1933. Thesis (C. E.) — Tulane University.

Deals with the tractive force of flowing water, critical tractive forces, practical applications, and acceleration of bed movement. Treats of laws of Du Boys, Reynolds, and Kennedy. Notes a derivation of the index of turbulence.

THOMPSON, R. H. See Roberts, W. J., 1.

THOMPSON, W. P.

1. The design of regulators for distributaries. *Punjab Engin. Cong., Minutes of Proc.*, vol. 8, pp. 61-64, illus., 1920.

Describes improvements in the design of regulators in order to avoid deposits of silt in the head reaches of distributaries.

THOMSON, ELLIS.

1. Quantitative microscopic analysis. *Jour. Geol.*, vol. 38, no. 3, pp. 193-222, illus., 1930.

Discusses quantitative microscopic analysis, considering some new variations of the Rosiwal method. Outlines the methods of Delesse, Rosiwal, Johannsen, Shand, and Wentworth.

THOMSON, JAMES.

1. On the origin of windings of rivers in alluvial plains, with remarks on the flow of water round bends in pipes. *Roy. Soc., London, Proc.*, vol. 25, no. 171, pp. 5-8, illus., May 4, 1876.

Presents an explanation for the wearing away of the outer bank and deposition along the inner bank of a river bend.

THOMSON, JOHN P.

1. A sedimentation-study on Clearwater River, Idaho. *Amer. Geophys. Union, Trans.*, vol. 16, pp. 492-495, illus., 1935.

Briefly describes a sedimentation study on the log pond behind the Lewiston Generating Station dam on the Clearwater River, Idaho. Describes Clearwater River and basin, Lewiston Generating Station dam, and effects of the flood of December 1933 on silt deposition in the pond. Notes that silt deposits impaired log-pond activity. Contour maps covering 66 acres at the lower end of the 780-acre pond showed that 253,777 cu. yd. of silt are in the pond, necessitating dredging operations.

THONE, FRANK.

1. What will the rivers do now? *Sci. News Let.*, vol. 31, no. 844, pp. 378-380, illus., June 12, 1937.

Gives a popular description of model experiments at the hydraulic laboratory of the National Bureau of Standards, Washington, D. C., in connection with studies of the effect of Boulder Dam upon the configuration of the bed of the Colorado River below the dam.

2. Silt and salmon [abstract]. *Sci. News Let.*, vol. 34, no. 19, p. 303, Nov. 5, 1938.

Abstract of a special bulletin by Dr. Henry Baldwin Ward giving results of his investigation, for the Oregon State Department of Geology and Mineral Resources, of the effect of silt derived from placer mining operations in the Rogue River watershed in Oregon on salmon. Dr. Ward states that the silt is not guilty of killing fish since it adds no toxic substance to the water and introduces no organic materials which absorb oxygen and thereby suffocate fish. It may even serve to protect fish by preventing them from seeing and being attracted by fishermen's lures. Laboratory tests at Reed College showed that fingerling salmon and trout got on just as well in tanks of muddy water as control groups in clear water.

THOREEN, R. C.

1. Comments on the hydrometer method of mechanical analysis. *Pub. Roads*, vol. 14, no. 6, pp. 93-105, illus., Aug. 1933.

Considers the various features of the hydrometer method of mechanical analysis. Discusses basic assumptions of Stokes' law. Notes apparatus developed in connection with hydrometer investigations. Compares different methods of analysis.

THORNTWHAITE, C. WARREN. See also Dobbins, W. E., 1.

1. (and Sharpe, C. F. Stewart, and Dosch, Earl F.). Climate and accelerated erosion in the arid and semi-arid Southwest, with special reference to the Polacca Wash Drainage Basin, Arizona. U. S. Dept. Agr., Tech. Bul. 808, 134 pp., illus., May 1942.

Discusses the meteorological origin of climatic fluctuations, the climatic pattern of the Southwest, and climatic fluctuations in the past. Describes erosion in the Polacca Wash, Ariz., the basic conditions governing erosion, present erosion conditions, and processes and effects of normal and accelerated erosion. Discusses accelerated erosion in the Southwest including date and causes of acceleration of erosion.

- THORP, E. M. See Brown, C. B., 31; Rittenhouse, G., 14.
- THORPE, W. H. See Buckley, A. B., 1.
- THRUPP, EDGAR CHARLES. See also Griffith, W. M., 1
1. Flowing water problems. *Inst. Civ. Engin., Proc.*, vol. 171, pp. 346-359, illus., 1908.
Deals with the mechanics of flowing water. Includes a discussion on the relation between mean velocity, hydraulic radius, and erosive or scouring power in open channels.
- TICKELL, FREDERICK G. See also Reed, R. D., 1; Russell, R. D., 7.
1. The examination of fragmental rocks. 549 pp., illus. Stanford University, Calif., Stanford Univ. Press, 1939.
Deals with the physical examination of fragmental rocks. Considers size analysis, porosity and permeability, preparation of specimens, and identification of minerals. Contains a bibliography dealing with articles on the subject.
- TIFFANY, JOSEPH B., JR. See also Kramer, H., 2.
1. (and Nelson, George A.). Studies of meandering of model-streams. *Amer. Geophys. Union, Trans.*, vol. 20, pt. 4, pp. 644-649, illus., Aug. 1939.
Describes and presents results of model studies conducted by the U. S. Waterways Experiment Station at Vicksburg, Miss., to afford an accurate, rapid, small-scale reproduction of variations in alluvial streams, particularly the phenomena of bar formation, caving of opposite banks, downstream progression of bends, and the formation of cut-offs and ox-bow lakes.
 2. Memorandum report on proposed model study of Southwest Pass. 27 pp. Vicksburg, Miss., U. S. Waterways Expt. Sta., 1944.
A report which concludes that the bed load constitutes the principal shoaling problem at the mouth of Southwest Pass.
- TIJMSMATA, S.
1. The silt content of the Deli River. *Deli Proefstate Medan, Meded. Ser. 2*, no. 7, pp. 24-29, 1919; [abstract], *Expt. Sta. Rec.*, vol. 42, p. 421, Apr. 1920.
Deals with results of observations on the dissolved and suspended load of the Deli River.
- TILTON, G. A., JR.
1. New combination bank protection constructed on Eel River near Dyerville. *Calif. Highways and Pub. Works*, vol. 21, no. 1, pp. 4-5, 20, illus., Jan. 1943.
Treats of bank-protection works constructed on the Eel River near Dyerville, Calif. The design used consisted of a rock riprap and flexible rock and wire mattresses.
- TIMONOFF, V. E.
1. A new method of dredging channels across sandy shallows in rivers [abstract]. *Engin. Rec.*, vol. 40, no. 24, p. 562, Nov. 11, 1899.
Describes a new method of dredging channels across sandy shallows in rivers. By this method current is not forced across the shallow, but the channel is dredged to induce current to flow along it. Notes trial of the method on the River Volga.
- TINCHER, GEORGE W.
1. Destructive erosion along the Kansas River. *Forestry and Irrig.*, vol. 10, no. 2, pp. 63-65, illus., Feb. 1904.
Describes damages incurred by erosion and the deposition of infertile sand along the Kansas River at Topeka, Kans. during the flood of May-June 1903. Deforestation left the ground in suitable condition for total destruction by overflow of the stream.
- TISDEL, F. W. See Krumbein, W. C., 21.
- TISON, L. J.
1. Erosion of sands. *Soc. Sci. de Bruxelles, Ann.*, vol. 58, pp. 225-235, Dec. 12, 1938; [abstract], *Sci. Abs.*, Sect. A, vol. 42, no. 494, p. 145, Feb. 25, 1929.
Determines minimum velocity of flow that causes erosion for water of various depths with different sized sand grains at the bottom of the stream.
- TODD, JAMES E.
1. River action phenomena. *Geol. Soc. Amer. Bul.*, vol. 12, pp. 486-490, 1901.
Discusses briefly various phenomena of river action. Considers scour of river bottoms during flood, the occurrence of mutual flood-relief channels above the junction of the currents of two streams, and the checking of current velocities when streams overflow their floodplains. Conditions of stream erosion and the transportation and deposition of sediment are noted in relation to the above phenomena. Illustrations are cited.
- TODD, O. J.
1. Flood control in China. *Assoc. Chinese and Amer. Engin. Jour.*, vol. 10, no. 3, pp. 4-10, Nov. 1929.
Deals with China's flood problems, including flood damages. Samples from the Yung Ting Ho during the floods of July and August 1924 ran as high as 22 percent solids. Studies made in 1919 show that the Yellow River was found to carry as high as 10 percent by volume of solids in solution while flowing at 7-8 ft. per. sec. Discusses the difficulty caused to shipping at Tientsin because of heavy silt deposits, dike breaching, and the problem of flood control.
 2. Wrestling with some of China's rivers. *Civ. Engin.*, vol. 3, no. 6, pp. 304-308, illus., June 1933.
Describes dikes and silt deposits of the Yellow River in China. The river carries a silt load from tributaries in Shensi and Shansi, dumps its mud load into the Gulf of Chihli, and builds its delta farther eastward yearly. The river discolors the Yellow Sea, giving it its name, and silts its own bed each autumn. Summer floods scour the channel clear each year. The minimum flow is 10,000 cu. ft. per sec., the maximum flood flow is estimated at 350,000 cu. ft. per sec. Near Shantung, flood waters have shown 12 percent of silt by weight. At Tengchow, Suiyuan, above the Shansi and Shensi tributaries, a maximum of only 4 percent silt was found in 3 yr. sampling. On King River, which flows into the Wei River and then joins the Yellow River near Tungjuan, Shansi, in the summer of 1932 the silt load reached 48 percent by weight. No storage of Yellow River water is attempted because of silting. Describes the use of a Kaoliang pak groin for dike repair. Notes a change in the river course due to a dike break, and the turning of the river back into its original course.
 3. A review of Saratsi Irrigation Project. *Assoc. Chinese and Amer. Engin. Jour.*, vol. 16, no. 3, pp. 139-148, illus., May/June 1935.
Describes the history of the development of the Saratsi Project, China. Notes briefly the silt content of the Yellow River at the intake to canals of the project. States that the soil to be irrigated is mainly river silt and capable of producing good yields. Some land patches need deep deposits of new mud to make cultivation practicable.
 4. The Yellow River dike breaks of 1935. *Assoc. Chinese and Amer. Engin. Jour.*, vol. 17, no. 3, pp. 126-138, illus., May/June 1936.
Describes the work involved in closing a dike break which occurred on the Yellow River near Linapochi, Shantung, during the flood of July 1935. Includes two paragraphs describing damages due to sediment deposits on the flood plain. The maximum mud load in flood was as high as 25 percent solids by weight. The town of Linapochi was buried in concentrated mud of 8-10 ft. in depth.
 5. (and Eliasson, Sig.). [Review of] Hydraulic and road questions in China. *Assoc. Chinese and Amer. Engin. Jour.*, vol. 17, no. 6, pp. 333-351, Nov./Dec. 1936.
Reviews a technical report by the Committee of Experts of the League of Nations (213 pp. Geneva, 1936) on hydraulic and road questions in China. Comments critically on findings of the League's investigator relative to the engineering features and effectiveness of the Wei Pei, Lo Ho, and Saratsi projects, and the proposed Kuang Ting Reservoir. The problem of handling silt, in connection with these works is considered.
 6. China's Ol' Man River. *Sci. Amer.*, vol. 156, no. 1, pp. 5-9, illus., Jan. 1937.
Gives an account of damages resulting from the Yellow River floods of 1933 and 1935, including dike breakage, stream meandering, silt

- deposits of 6-8 ft. in depth on flood plains, and methods of dike repair.
7. Floods recede on Yellow River. *Engin. News-Rec.*, vol. 120, no. 25, p. 864, June 23, 1938.
Describes the 1938 flood on the Yellow River in China, noting data on floods of past years, areas flooded, and damage done. The flood most likely was caused by military forces purposely breaking dikes in the Kaifeng and Chengchow regions. Land is benefited rather than injured by the deposition of fertile loess silt.
 8. Present-day irrigation methods in China. *Civ. Engin.*, vol. 8, no. 8, pp. 527-530, illus., Aug. 1938; also in *Assoc. Chinese and Amer. Engin. Jour.*, vol. 19, no. 5, pp. 238-242, Sept./Oct. 1938.
Discusses various aspects of irrigation practice in China. Considers briefly the feasibility of irrigation reservoirs, noting the silt problem involved. Describes the successful application of the siphon method of irrigation along the Yellow River in Honan and Shantung Provinces in connection with land reclamation, since it is desirable to cover alkali lands near the mouth of the Yellow River with silt-laden waters.
 9. Regulation of the Yellow River. *Assoc. Chinese and Amer. Engin. Jour.*, vol. 19, no. 6, pp. 334-384, Nov./Dec. 1938.
Presents results of investigations relative to the regulation of the Yellow River, particularly with respect to the control of floods and to flood damages to the Great Plains of China. Gives the plan of flood control and regulation, the regimen of the Yellow River, previous studies on the hydraulics of the stream, general surveys of silt and flood situations, and hydraulic laboratory experiments. Describes dike breaks and methods of closing breaches, physiography and hydrology of the Yellow River drainage area, rainfall, runoff, silt flow, scour and refill of river bed, etc.; proposed methods of decreasing flood hazards, such as detention basins, spillway basins, bypass channel, earth dikes and their protective works, dikes channel regulation and methods of channel stabilization, soil erosion control, and control of runoff by reforestation; and river utilization for power development, irrigation, fertilization by flooding with silt-laden waters, and navigation. The silt aspects of the problem are considered throughout the entire report.
 10. (and Eliassen, S.). The Yellow River problem. *Amer. Soc. Civ. Engin.*, Trans., vol. 105, pp. 346-416, illus., 1940; also in *Amer. Soc. Civ. Engin.*, Proc., vol. 64, no. 10, pp. 1921-1992, illus., Dec. 1938.
Deals with the problem of controlling the Yellow River, including early attempts at control; recent investigations; hydraulic laboratory experiments on the effect of stream contraction on bed scour; dike breaching; physiography of its basin; regimen of the stream, silt flow characteristics, scour, and refill; bed movement; methods of decreasing flood hazards by detention basins, spillway flow into basins, bypass channel, dikes, channel stabilization, soil-erosion control, and afforestation; silt problems involved; utilization of the Yellow River for power and irrigation purposes; and damages and benefits from sand and good silt deposits.
Discussion: J. W. BEARDSLEY, pp. 417-418, notes the volume-weight relationship of deposited Yellow River silt. Comments upon and notes means of utilizing the fertilizing value of the silt. ELLIOT J. DENT, pp. 418-425, considers the possibility of increasing bed-load capacity of the Yellow River and inducing bed scour by reducing the width of the stream. Notes that the project for the control of the Yellow River should provide for the deposit, in a selected area, of a huge volume of the coarsest sediment. HERBERT CHATLEY, pp. 425-427, states that choking of the channel after a flood is a major objection to the use of bank-edge dikes, and suggests that dikes be widened by building up adjacent areas with flood silt. Notes the need for model studies on

the hydraulic problems of a silt-bearing stream. H. VAN DER VEEN, pp. 427-433, deplores the fact that surveys and studies of the action of the Yellow River have not stressed the immediate necessity for various localized engineering works to ameliorate the various problems of the stream. Discusses the effect of the dike system upon conditions of equilibrium of the Yellow River. Comments upon the author's proposed plans dealing with flood control and regulation, and favors use of spillway basins in the plains and bypass channels, since these measures would tend to desilt the waters of the Yellow River. C. S. JARVIS, pp. 433-434, reiterates briefly the methods of securing flood relief, and suggests corrective and regulatory works in the Wei Ho basin. E. W. LANE, pp. 434-441, stresses the importance of sediment control along with stream control in the consideration of the flood problem of the Yellow River. Comments on the proposed use of retarding basins. Discusses methods of sediment control by soil erosion-control methods, by carrying sediment to the sea, and by controlled storage of sediment. Notes the necessity for continuous construction work to control the stream. Data on size distribution of sediment in the Yellow River are given, compared with American rivers. GEORGE HIGGINS, pp. 441-443, speaks of the use of spillways along the entire length of the Yellow River where flow is above the level of adjacent country. THE AUTHORS, pp. 443-453, note the effect of the dike break of June 1938 upon the change in course of the Yellow River, and suggests that the plan proposed by the writers for regulation of the stream be applied to the course it held (1851-1938). Comment is made upon previous discussions dealing with land reclamation by broad-flooding of wide areas; silt inflow, deposition, and outflow for the Shanchow-Chinchang reach; tributary flow; advance of delta; hydraulic laboratory experiments; localized improvements to ameliorate flood conditions; erosion control; dredging; Yellow River tributary control; silt transportation and deposition, etc.

TOLMAN, C. F.

1. Erosion and deposition in the southern Arizona bolson region. *Jour. Geol.*, vol. 17, no. 2, pp. 136-163, illus., Feb./Mar. 1909.

Discusses the conditions of and factors affecting the geological processes of erosion and deposition in the southern Arizona bolson region. Includes discussion on conditions of erosion and transportation and on deposition of sediments by flowing water.

TOLMAN, RICHARD C.

1. (and Vliet, Elmer B.). A Tyndallmeter for the examination of disperse systems. *Amer. Chem. Soc. Jour.*, vol. 41, no. 3, pp. 297-300, illus., Mar. 1919.

Describes a form of Tyndallmeter developed by the Dispersoid Section, Research Division, U. S. Chemical Warfare Service. The instrument can be used in determining the strength of the Tyndall beam in suspensions, colloidal solutions, mists, and smokes.

2. (and others). Relation between intensity of Tyndall beam and size of particles. *Amer. Chem. Soc. Jour.*, vol. 41, no. 4, pp. 575-587, illus., Apr. 1919.

Roscoe H. Gerke, Odin P. Brooks, Albert G. Herman, Robert S. Mulliken, and Harry DeW. Smyth, joint authors.

Reports an investigation to determine the relation between the strength of the Tyndall beam and the size of particles.

TOMPKINS, WILLIAM F.

1. The Bonnet Carre spillway in the flood of 1937. *Military Engin.*, vol. 30, pp. 43-47, illus., Jan./Feb. 1938.

Describes the design, construction, and results of operation of the Bonnet Carre spillway; the conditions of sand deposition and scour in the spillway; corrective measures; the effect of spillway discharge in reducing the salinity and muddying the waters of Lake Pontchartrain, and the effects on fishing in the lake.

2. The use of asphalt in river and harbor construction. Asphalt Inst. Construct. Ser., 43, pp. 3-13, illus., Aug. 1, 1938.
Deals with asphalt in various river and harbor construction works. Includes a description of details of construction and discusses the effectiveness of asphalt mattresses for river-bank protection.
- TOMSON, FRANK D.**
1. Missouri River bank protection at Omaha. Engin. World, vol. 21, no. 5, pp. 297-299, illus., Nov. 1922.
Describes engineering details and the effectiveness of standard current retards for the protection of river banks against erosion. Describes protective works along the Missouri River at Omaha, Nebr.
- TORRANCE, WM.**
1. Observations on soil erosion. Union So. Africa, Dept. Agr., Bul. 4, 32 pp., illus., 1919.
Presents results of observations on conditions of soil erosion in the Karroo, Union of South Africa. Includes brief discussions on stream erosion, chemical and physical character of silt in streams, gullying, and sedimentation in stream channels and on flood plains. Data on solids in suspension carried by Karroo flood waters are given.
- TORREY, W. L.** See Symons, G. E., 1.
- TORRICELLI, G.**
1. Notes upon the more important features of large reservoirs for irrigation [abstract]. Van Nostrand's Engin. Mag., vol. 35, no. 216, pp. 445-447, Dec. 1886.
Discusses some of the more important features of irrigation reservoirs with particular reference to the peculiarities of certain dams in Algeria. The problem of silting up of irrigation reservoirs is briefly considered and brief data are given on rates of silting in the Hahra, Sig, Tielat and Djidionia reservoirs in Algeria. Notes that the paper discusses various methods of silt removal from reservoirs.
- TOWER, WALTER SHELDON.**
1. The Mississippi River problem. Geog. Soc. Phila. Bul., vol. 6, no. 3, pp. 9-26, July 1908.
Emphasizes the need of a deep waterway from the Great Lakes to the Gulf of Mexico. Several pages (pp. 12-22) deal with bank erosion and transportation and deposition of sediment by the Mississippi and Missouri Rivers. Concludes with a discussion of the relative feasibility of various schemes for improving this waterway.
- TOWL, ROY N.**
1. Missouri River bank protection at Omaha, Nebraska. Amer. Soc. Civ. Engin., Trans., vol. 85, p. 1482, 1922.
Notes the efficiency of current retards used for bank protection on the Missouri River at Omaha, Nebr., and gives a description of construction methods.
 2. Silt and silting basins on drainage works [abstract]. Engin. News-Rec., vol. 92, no. 12, pp. 488-489, illus., Mar. 20, 1924.
Abstract of a paper read before the National Drainage Congress on the design of settling basins on drainage projects, particularly noting Hill Creek settling basin on the Burt-Washington drainage district at Herman, Nebr. which encloses an area of about 40 acres and employs the principle, advocated by the author, of spreading out the overflow into a shallow broad sheet. This reduces velocity, drops the silt and builds up land which can be successfully planted and farmed. Overflow water is collected in a lateral canal at least 1/4 mile from overflow point. In a distance of 1/4 mile all the silt which would damage a drainage ditch will be dropped. Note is made of damage by silting ditches in Fremont County, Iowa (Burlington RR) and Woodbury County, Iowa (C.M. & St.P. Ry.) where raising of bridges and main line was necessitated.
 3. Handling silt in settling basins. Engin. and Contract., vol. 62, no. 2, pp. 341-344, illus., Aug. 13, 1924.
Discusses silt handling in settling basins in connection with drainage work along the Missouri River. Notes that some drainage districts provide settling basins, diversion ditches and floodways for the control of silt. Discusses the economic effect of the silting of drainage ditches. Cites examples of floodway construction with silt deposits. The best settling basin is described as a natural one where the overflow spreads out near the base of the debris and flows out in a thin, wide sheet over the fan while the decrease in velocity induces deposits of silt and a pick-up ditch on the lateral returns the water to the channel. Notes that natural settling basins can be farmed to corn. Describes the Hill Creek settling basin at Herman, Nebr., noting that the average annual fill for a 5-yr. period has been 4 in. per yr. A description of a special design for economical construction of a floodway ditch is given.
- 4. Silt control by flooding.** Engin. World, vol. 26, no. 4, p. 254, Apr. 1925.
Cites instances of recent silt deposition by flooding, and describes the design of a system for the control of silt in drainage projects. Proposes a means of artificially flooding the valley of the Loup region in Nebraska to cover sterile sands and clays with fertile silt, by constructing short division ditches running out from the stream. The extent of recent silt deposition in the Nishnabotna Valley, Fremont County, Iowa, and the deposition of silt by flooding a field of low-bottom land near Tekamah, Nebr. are described.
- 5. Flood regulation and silt control on the Silver Creek Floodway.** Agr. Engin., vol. 8, no. 11, p. 304, illus., Nov. 1927; [abstract], Amer. Soc. Agr. Engin., Trans., vol. 21, p. 22-LR, illus., 1927.
Discusses flood regulation and silt control at Silver Creek Floodway near Tekamah, Nebr. Discusses berm formations on floodway and deposition of sediment by floods of June and September 1926. Sediment 6-8 in. deep was deposited within 200 ft. of levees, decreasing in thickness to 1/4 in. 1/4 mile from the floodway. Presents a plan to use 500 acres of land adjoining the floodway to regulate floods and control silt by inducing vegetation between parallel dikes to retard water and cause sedimentation, thus permitting clear water to transport sediment from other sources.
- 6. Silt control for drainage and flood ditches.** Agr. Engin., vol. 8, no. 12, p. 334, Dec. 1927; [abstract], Amer. Soc. Agr. Engin., Trans., vol. 21, p. 26-LR, illus., 1927.
The growth of the Colorado River Delta and the rise of the old river bed 1 ft. per yr. for 13 yr. are noted. Includes discussion of factors affecting silt transportation, restriction of sedimentation at its source, and prevention of sedimentation in drainage ditches by using lowlands as settling or overflow basins.
- 7. The Scheiffle System of river bank protection.** Agr. Engin., vol. 10, no. 1, p. 36, Jan. 1929.
Describes the use of willow poles planted on river banks to protect them from erosion. Butts placed at or below water level extend up the slope to the top of the bank. Parallel poles are covered lightly with earth and allowed to develop a root system and a cover of willow shoots which appear above ground. The system introduced by O. S. Scheiffle of Waterloo, Ontario, has been successfully employed to protect banks above the water level on a number of projects. Protection below the water level must be effected by other means.
- 8. Behavior of rivers in alluvial flood plains.** Engin. News-Rec., vol. 102, no. 11, pp. 433-435, illus., Mar. 14, 1929.
Describes the meandering and straight portions of the courses of the Mississippi, Missouri, Big Sioux, Platte, Arkansas, and White Rivers. The relative stability and destructiveness of straight and crooked portions are compared and the effect of straightening or controlling crooked portions is discussed.

9. The behavior history of the "Big Muddy." Engin. News-Rec., vol. 115, pp. 262-264, Aug. 22, 1935. Describes the natural straightening of the channel of the Missouri River between Sioux City and Portsmouth. Straightening changed the river from 250 miles in 1804 to 150 miles in 1935. Heavy timber growth on the banks held the river in its old course. Removal of trees removed resistance to the natural energy of the river and allowed it to shorten its course. The old river continually transported sedimentary material from bank to bank, forming new bends, cut-offs, etc. The flood of 1881 caused a great change in the river course, no new cut-offs having been formed since then. Lewis and Clark National Park was proposed to embrace an abandoned river bend area. The new channel was confined to 1/3 of a mile width at four points, causing ice gorges to form at these narrow points. The new straightened river is free of the destructive floods formerly encountered. Fort Peck Reservoir is to aid the river to maintain a clear channel.

TOWNSEND, CURTIS McDONALD. See also Freeman, J. R., 2; Red Cross. U. S. American National Red Cross, Board of Engineers, 2.

1. Controlling the Mississippi River. Engin. News, vol. 68, no. 18, pp. 832-835, Oct. 31, 1912; also in Sci. Amer. Sup., vol. 75, no. 1931, pp. 6-7, Jan. 4, 1913.

Discusses the value of controlling floods on the Mississippi River by levees, the influence of forests on stream flow, the influence of reservoirs in controlling floods, and the effect of cut-offs and use of outlets and waste weirs on flood heights. Notes the agricultural value of material eroded from hills and carried down by rivers to lowlands and lower reaches and the possibility of outlets filling with sediment when the velocity of the stream is decreased. Discusses the effect of levees on the level of the river bed (notes foreign studies), the effect of velocity on silting and scouring of bars and pools, the necessary height of levees, the results of the flood of 1912, the protection of caving banks, and foundations for levees. Notes that levees tend to remove irregularities in a stream and make the slope more uniform.

2. The flow of sediment in the Mississippi River and its influence on the slope and discharge with special reference to the effect of spillways in the vicinity of New Orleans, La. 19 pp., illus. St. Louis, Mo., U. S. Miss. River Comm., 1915.

Discusses results of investigations on the flow of sediment in the Mississippi River, conditions of bar formation, and the influence of bars on the regimen of the stream, in connection with the influence of proposed spillway construction in the vicinity of New Orleans upon changes on river section, reduction in flood heights, and conditions of sediment transportation and deposition. Examines the data and concludes that the project would be impractical since maintenance after construction would require an enormous amount of dredging.

3. The flow of sediment in the Mississippi River and its influence on the slope and discharge. Military Engin., vol. 7, no. 33, pp. 357-377, illus., May/June 1915.

Discusses the flow of sediment in the Mississippi River, its influence on slope and discharge, and the influence of spillways in the vicinity of New Orleans. Notes early investigations on transportation of sediment by the Mississippi and Missouri Rivers; observations relative to material in solution and suspension; relation between gauge heights and amount of sediment in suspension; relation between discharge, flow of sediment, and distribution of sediment below the junction of the Mississippi and Missouri Rivers; effect of velocity, watershed conditions, and rainfall on amount of sediment in streams; effect of checked velocities on deposition; rate of movement and depth of downstream bed-load movement in the form of "sand waves," citing instances; currents and bank caving at bends; model studies; effect of

bends on movement of sediment; influence of discharge on radius of river bends in Atchafalaya, Illinois, and Mississippi Rivers. Effect of slope of streams on flow of sediment, sedimentation, and bed-load movement.

4. Problems at mouth of the Mississippi. Military Engin., vol. 18, no. 98, pp. 99-106, illus., Mar./Apr. 1926.

Discusses historically some of the hydraulic problems involved in improving the mouth of the Mississippi River, and presents a general description of the improvement works. Notes briefly conditions of sediment transportation by the Mississippi. Describes improvements to South and Southwest Passes by jetty construction and dredging (1875, 1900, and 1923); maintenance difficulties; conditions of scour and deposit in the passes; observations of the effect of salt water inflow from the Gulf as a factor in modifying channel depths. Presents in graphic form and discusses data pertinent to the question of bar formation.

5. Remarks on the Finger Lake floods. Military Engin., vol. 27, no. 156, pp. 413-414, Nov./Dec. 1935.

Compares the flood in the Finger Lake region of New York to floods of the Pasig and Bug Rivers in the Philippine Islands. The author particularly points out that the construction of railways and roadways to an even grade, requiring cuts and fills, creates a disturbance to natural runoff of storm water which tends to be dammed by the fills and to deposit silt in and scour earth from the walls of the cuts. The undermining of bridge abutments and of roadways is noted, as is the diversion of flood waters from their normal channels by the filling of the channels with rocks and detritus deposited in the stream bed. This was a particular feature of the Finger Lake floods.

TRAINER, D. M., JR. See Nevin, C. M., 1.

TRASK, PARKER D. See also Lane, E. W., 22; Twenhofel, W. H., 11; Vanoni, V. A., 5.

1. Sedimentation tube for mechanical analyses. Science n. s., vol. 71, no. 1843, pp. 441-442, illus., Apr. 25, 1930.

Describes dispersing tubes and a sedimentation tube used in the mechanical analysis of sediments. Gives procedure used.

2. Mechanical analyses of sediment by centrifuge. Econ. Geol., vol. 25, no. 6, pp. 581-599, illus., Sept./Oct. 1930.

Describes the use of the regular centrifuge method, based on Stokes' law, which governs the rate of fall of particles through liquids as applied to a new procedure for mechanical analysis of sediments. Describes improved processes of dispersion, decanting, and centrifuging to determine the percentage of weight of finer particles which settle, as a ratio of time and rate. Sample curves of functions of weight of sediment for time values are plotted and size distribution of constituents in percentile diameters is ascertained from these curves. The mathematical basis of procedure and the value of the method are discussed.

3. Sedimentation in the Channel Islands Region, California. Econ. Geol., vol. 26, no. 1, pp. 24-43, illus., Jan./Feb. 1931.

Presents preliminary results of investigations by the American Petroleum Institute of conditions under which sediments, that may be the source of beds of petroleum, are now accumulating. Gives mechanical and chemical analyses of sediments from the Channel Islands Region, Calif.; location of samples; results of mechanical analyses and method of analysis; relation of sediments to bottom configuration; factors affecting texture of ocean bottom sediments; comparative coarseness of fine-grained deposits in this region and corresponding sediments; forming of master streams as the Mississippi, Orinoco, and McKenzie; correlation of relative coarseness of Pacific deposits with greater land relief, indicating a possibility of determining the relief of regions supplying sediment for deposits; distribution of calcium carbonate and nitrogen sediments of the Chan-

- nel Islands; determination of organic content of marine sediments; and ratio of organic carbon to nitrogen in Recent marine sediments.
4. Studies of Recent marine sediments conducted by the American Petroleum Institute. Natl. Res. Council Bul. 89, pp. 60-67, Nov. 1932.
Presents a summary of the results of investigation on the Origin and Environment of Source Sediment (Proj. 4, American Petroleum Institute Research Program). Describes methods for the measurement of the quantity of organic matter and of calcium carbonate in samples procured from 150 environments over the entire world, determination of the texture of each specimen, mechanical analysis of samples, nature of organic constituents of representative samples, etc.
 5. Organic content of Recent marine sediments. In Trask, P. D., ed. Recent marine sediments; a symposium, pp. 428-453. London, T. Murby and Co., 1939.
Deals with the determination of organic matter in sediments, placing particular emphasis on the determination of the organic content of Recent marine sediments.
 6. (editor). Recent marine sediments; a symposium... published by the American Association of Petroleum Geologists, Tulsa. 736 pp., illus. London, T. Murby and Co., 1939.
A symposium on Recent marine sediments which presents papers by specialists in various fields. Covers such subjects as transportation of sediment, relation of oceanography to sedimentation, deposits associated with the strand line, near-shore sediments, pelagic deposits, special features of sediments, and methods of study, mechanical analysis, organic content, graphic representation, statistical analysis, mineral analysis, X-ray methods, and bottom-sampling apparatus.
- TRATMAN, E. E. See Coppee, H. St. L., 1.
- TRAUTMAN, MILTON B.
1. The general effects of pollution on Ohio fish life. Amer. Fisheries Soc., Trans., vol. 63, pp. 69-72, 1933.
Classifies pollution according to the various effects upon fish. Pollutents which affect fish directly and indirectly include acids which injure delicate gills and pollutants which cover the gills of fish. Pollutents affect fish by injuring gills and internal parts, by clogging gills, and by affecting the character of the water and bottom conditions. Sediment, when present in sufficient quantities, covers the gills of fish and prevents respiration. Major effects of sediment on fish are caused by changes on stream bottom affecting nesting grounds and destroying fish food.
- TRAXLER, R. N.
1. (and Baum, L. A. H.). Measurement of particle size distribution by optical methods. Amer. Soc. Testing Mater., Proc., vol. 35, pt. 2, pp. 457-467, illus., 1935.
Discusses studies of factors which influence the measurement of particle size by the use of the Wagner turbidimeter. Concludes that a direct proportionality does not exist between turbidity and surface area. Notes that, for changes of size distribution in a single product, the method has value.
Discussion: P. S. ROLLER, p. 468, comments on the consideration given to the size measurement of each particle and the use of indirect methods of determining particle size. L. A. WAGNER, pp. 469-471, notes that the selection of any one method or apparatus for the true measure of size and surface of powder material is questionable. Makes various criticisms of the paper. R. N. TRAXLER, pp. 470-471, treats the criticisms presented by Mr. Wagner. Concludes that accuracy of the turbidimeter could be increased if it were equipped with a 100 millimeter and not a 50 millimeter.
- TRENCH, W. L. C. See also Griffith, W. M., 1.
1. Notes on "tortuosity of rivers." India Cent. Bd. Irrig., Pub. 11, pp. 30-32, 1936.
Discusses briefly existing tortuosity in streams of India, the factors which control it, and conditions under which it will increase or decrease.
- TROMP, K. F.
1. Ultimate velocity of fall in restricted space. Fuel in Sci. and Pract., vol. 24, no. 5, pp. 126-135, illus., Sept./Oct. 1945.
Treats the formulas of Munroe and Spée. Suggests a new formula of motion and derives one for falling velocity in restricted spaces. Suggests a shape coefficient that can be read from an auxiliary graph for calculating the ultimate velocity of fall of non-spherical particles in restricted spaces.
- TROWBRIDGE, ARTHUR C. See also Twenhofel, W. H., 1.
1. A classification of common sediments and some criteria for identification of the various classes. Jour. Geol., vol. 22, no. 4, pp. 420-436, illus., May/June 1914.
Presents a classification of common sediments and gives various characteristics of the different types; includes a key table for the identification of the various classes. Sediments are classified as eolian, fluvial, pluvial, talus, glacial, lacustrine, and marine.
 2. (and Shaw, Eugene Wesley). Geology and geography of the Galena and Elizabeth Quadrangles. Ill. Geol. Survey Bul. 26, 233 pp., illus., 1916.
Discusses the geology and geography of the Galena and Elizabeth Quadrangles in the southern part of the Driftless Area in adjacent parts of Wisconsin, Minnesota, Iowa, and Illinois. Contains a chapter on the work of streams in the region. Considers the principles of stream erosion, history of a valley, terrace, alluvium, etc. Notes the effects of the work of man such as chopping down of forests, cultivation, and grazing. These works of man caused the cutting of gullies and trenches into alluvial valley filling.
 3. Sedimentation at the mouths of the Mississippi River—Preliminary report [abstract]. Geol. Soc. Amer. Bul., vol. 34, p. 95, Mar. 30, 1923.
Notes that the report presents results of observations at the mouths of the Mississippi River relative to the flood of 1922, the relations of turbidity and total load to the maintenance of navigable channels, the closing by deposition of some of the mouths of Pass at Loure, the depth of the delta material, the method and rates of advance of the delta, the constitution of deposits on the natural levees in the passes, bays and on offshore bars; the relation of various engineering projects to sedimentation, etc.
 4. Disposal of sediments carried to the Gulf of Mexico by Southwest Pass, Mississippi River [abstract]. Geol. Soc. Amer. Bul., vol. 38, p. 148, Mar. 30, 1927.
Results of analyses of 541 samples of sediment collected by the U. S. Coast and Geodetic Survey from the bottom of the Gulf of Mexico near the mouth of the Southwest Pass of the Mississippi River in 1921-22, in order to obtain data on the disposal of sediments carried by the Southwest Pass and to determine the nature of marine sediments deposited at or near the mouths of rivers.
 5. Investigations of fluvial deposits. Natl. Res. Council, Reprint and Cir. Ser., no. 92, pp. 104-122, 1930.
Attempts to bring together the more important references dealing with river deposition and deposits. Contains a bibliography of 227 references, both foreign and United States, which deal with the problem of fluvial deposits.
 6. Building of Mississippi Delta. Amer. Assoc. Petrol. Geol. Bul., vol. 14, no. 7, pp. 867-901, July 1930.
Presents some facts and principles related to the manner of building of the Mississippi River Delta. Discusses location of deltas, characteristics of the delta sediment, existing conditions at the distributaries of the stream, conditions at the passes, and method and rate of delta building.

TROXELL, HAROLD C. See also Hoyt, W. G., 1; Lynch, H. B., 1.

1. (and Peterson, John Q.). Flood in La Canada Valley, California, January 1, 1934. U. S. Geol. Survey, Water-Supply Paper 796-C, pp. 53-98, illus., 1937. Deals with the southern California flood of Jan. 1, 1934, in La Canada Valley. Presents results of a detailed analysis of the causes and mechanics of debris movement in the valley with particular reference to debris movement in the Pickens Creek drainage area; factors influencing the movement of debris; adaptation of stream bed to discharge and debris movement; movement of debris across the debris cone; debris composition and its influence on debris movement; measurement of debris (Haines Canyon); sources of debris, such as soil erosion slides and stream-channel deposits; and effects of the storm of Jan. 1, 1934 upon other watershed areas.

TRUDEAU, ARTHUR G.

1. New type brush revetment. Engin. News-Rec., vol. 119, pp. 759-761, Nov. 4, 1937. Discusses design, construction and use of brush revetments on streams in Western Washington which are short and carry heavy debris loads from the mountains as well as flood flows from melting snows. Designs are based on low material cost and a large available supply of common labor. The bank is first graded to a 1 on 3 slope using draglines, teams and scrapers. At least 30 percent of the revetment brush is willow, the remainder fir. Brush should be 12-20 ft. long, with butts not over 4 in. in diameter. Describes in detail the steps in constructing the revetments. Details of cost and a bill of materials are included.

TRULLINGER, R. W.

1. [Review of] Erosion and silting of dredged drainage ditches, by C. E. Ramser. Agr. Engin., vol. 12, no. 3, p. 99, Mar. 1931. Reviews a bulletin of the U. S. Department of Agriculture (Ramser, C. E., 7) on results of observations and cross-sectional and hydraulic measurements made between 1913 and 1921 on 22 dredged drainage ditches in Mississippi, Tennessee and Iowa. Erosion and silting conditions in channels are described. It is noted that little erosion of alluvial clay occurs where velocity is much less than 3 ft. per sec. Discusses the relation of silt movement and bed-load movement to channel velocity stage and slope, correlation of results with those calculated by the Kennedy formula, and the effect of vegetation on channel walls.

TRUOG, E.

1. (and others). Procedure for special type of mechanical and mineralogical soil analysis. Soil Sci. Soc. Amer., Proc. (1936) vol. 1, pp. 101-112, illus., 1937. J. R. Taylor, Jr., R. W. Pearson, M. E. Weeks, and R. N. Simonson, joint authors. Gives a procedure for removing or dispersing colloidal binding and interfering material sticking to surfaces of larger soil particles in order to facilitate mechanical and mineralogical analyses.

TSURUMI, KADZUYUKI.

1. Experiment on settling velocities of fine particles [abstract]. Imp. Acad. Japan, Proc., vol. 11, no. 10, p. 455, 1935. Briefly presents results of experiments on the rate of settling of fine particles in liquids. States that experiments prove the accuracy of the author's previously determined formulas for terminal velocities attained for the settling of particles of various sizes.

TU, YUN-CHENG. See also Mavis, F. T., 2.

1. Sediment transporting power in open channels. 140 pp. June 1934. Unpublished thesis (Ph. D.) — State University of Iowa; [abstract], Iowa Univ. Studies in Engin. Bul. 19, pp. 57-58, May 1938. Presents tests made in a glass-walled flume to study the phenomena of bed-load movement and to determine the critical velocity at which granular materials of different sizes and densities start to move under controlled conditions. Gives the following conclusions: (1) The trans-

porting power of flowing water varies with the 6.75th power of the critical velocity; (2) if there is no obstruction which changes the normal velocity-depth curves, there is virtually a constant relation between the critical bottom velocity and the critical mean velocity; (3) if two granular materials have the same diameter and different densities, the critical velocity varies as the square root of (S-1), in which S is the specific gravity of material; (4) within reasonable limits, the shape of the particles of bed-load material does not affect the transporting power appreciably; (5) disturbances created by obstacles decrease the critical velocity; and (6) the critical velocity for a mixture is virtually the same as that for the unigranular material of the mean diameter of the mixture.

TURLEY, JAY.

1. The Carson Reclamation District, in Taos County, New Mexico. Colo. Soc. Engin., Denver, Engin. Bul., vol. 8, no. 4, pp. 13-15, Apr. 1924. Briefly describes plans for flood protection and for the reclamation of lands of the Carson Reclamation District, Taos County, N. Mex. Present conditions and effects of sand, silt, and debris deposition in the channel of the Rio Grande between Velarde and San Marcial, N. Mex. are briefly described.

TURNEAURE, F. E.

1. (and Russell, H. L.). Public water supplies. 704 pp., illus. London, John Wiley and Sons, 1940. Deals with various aspects of public water-supply problems. Includes brief discussions on soil pollution of surface waters; sedimentation by salting out effect, as evidenced by the delta formation at the mouth of the Mississippi River; silting up of reservoirs, noting rates of silting of Kensico, Austin and Zuni Reservoirs; control of reservoir silting; character of suspended matter in various streams; amount of sediment carried by various river waters; and rates of settling of particles of sand and silt in water.

TWENHOFEL, W. H. See also Tester, A. C., 3, 4.

1. Notes and comments relating to sediments and sedimentation. Natl. Res. Council, Div. Geol. and Geog., Com. on Sedimentation, Rpt. 1922-23, pp. 54-57, 1923. Comments upon the inability of mechanical analyses of sediments to yield data that bear on the interpretation of the conditions and environments in which the deposition took place, the need for additional data relative to structural features of sedimentary rocks, and the necessity for extensive studies on conditions of deposition and erosion on the sea bottom. Discussion: A. C. TROWBRIDGE, pp. 57-59, doubts the accuracy of Oden's method of analysis for the determination of sizes of particles and rates of deposition at the time of the original deposition; and presents observations on conditions of deposition in the Mississippi River near Pilotown, above Head of Passes, and at the East Bay ends of artificial outlets from South Pass. MAX LITTLEFIELD, pp. 59-61, presents results of observations on the rates of settling of fine sediments; and the effects of electrolytes upon rate of settling, of concentration of electrolytes upon time required for flocculation, and of sand additions upon the behavior of fine sediments.
2. Subaqueous formation of mud cracks. Natl. Res. Council, Div. Geol. and Geol., Com. on Sedimentation, Rpt. 1924-25, pp. 75-76, 1925. Notes the occurrence of the subaqueous formation of mud cracks over the bottom of small pools in the region about the Big Horn Mountains, and discusses experiments to determine the cause of cracking. Notes the geologic application of the phenomenon.
3. Treatise on sedimentation. Ed. 2, 926 pp., illus. Baltimore, Williams and Wilkins Co., 1932. A treatise on sedimentation which discusses sources and production of sediments; transportation, deposition, diagenesis and lithification of sediments; conditions modifying the process of sedimentation; sediments and organisms; products of sedimentation; structures, colors,

- and textures of sediments; environments of sediments; and studies of sediments in the field and laboratory.
4. The physical and chemical characteristics of the sediments of Lake Mendota, a fresh water lake of Wisconsin. *Jour. Sedimentary Petrology*, vol. 3, no. 2, pp. 68-76, illus., Aug. 1933.
Presents results of a study of the physical and chemical characteristics of the sediments of Lake Mendota, Wis. Includes two paragraphs briefly describing sampling apparatus and method of obtaining samples.
 5. Terminology of the fine-grained mechanical sediments, Natl. Res. Council, Div. Geol. and Geog., Com. on Sedimentation, Rpt. 1936-37, pp. 81-104, Oct. 1937.
Presents a historical review of the terminology of the fine-grained mechanical sediments now in use and recommends the retention of some terms and the abandonment of others. Considers such terms as alluvium, attritus, detritus, dust, marl, mudstone, loess, silt, clay, and shale. Includes a bibliography of 62 references.
 6. [Review of] Petrography of two Mississippi Subdeltas, by C. F. Dohm. *Jour. Sedimentary Petrology*, vol. 7, no. 3, p. 135, Dec. 1937.
Reviews a paper (Dohm, C. F., 1) dealing with the subdeltas in the Plaquemines and St. Bernard Parishes in Louisiana. Notes that literature relating to the sediments of the two parishes is reviewed and that the methods of mechanical analysis employed are described. Mentions that general results of the study indicate that dune sands show best sorting, followed in order by beach sands, channel deposits, and materials of the mud lumps.
 7. [Review of] Physiography of lower Mississippi Delta, by R. J. Russell. *Jour. Sedimentary Petrology*, vol. 7, no. 3, pp. 134-135, Dec. 1937.
States that the article (Russell, R. J., 1) considers topography, age, and land forms of the delta; thickness of sediments beneath the delta; the load upon basement rocks; evidence, rate, and causes of submergence; Gulf Coast Geosyncline; causes of mud lumps; rate of deposition of sediments; and thickness of alluvium of the delta. Notes Russell's statement that the Mississippi River transports daily an average of 2,000,000 tons of sediment to the lower delta.
 8. General procedure in studies of Recent sediments. In Trask, P. D., ed. *Recent marine sediments; a symposium*, pp. 525-531. London, T. Murby and Co., 1939.
Describes purposes, objectives, and procedure in the study of Recent sediments. Field studies, to include data relative to environmental conditions causing transportation and deposition, sampling of materials for laboratory inspection, and laboratory studies involving physical, chemical, mineralogical, and bacteriological analyses of sediment, are described. A flow sheet for the preparation of sediment samples for study is given.
 9. Principles of sedimentation. 610 pp., illus. New York, McGraw-Hill Book Co., Inc., 1939.
A textbook on sedimentation which covers the subject rather concisely, including the factor of environment; the origin, production, and composition of sediment; transportation and deposition; classification; sedimentary products; and colors, textures, and structures of sediment.
 10. The cost of soil in rock and time. *Amer. Jour. Sci.*, vol. 237, no. 11, pp. 771-790, Nov. 1939.
Deals with the geological cost of soils in terms of volume of rock destroyed and time necessary to produce a given thickness of soil materials. Discusses, in this connection, the vulnerability of various types of rock for destruction by various agents, the quantity of soil resulting from each variety of rock, and the rate of rock destruction.
 11. [Review of] Recent marine sediments; a symposium, ed. by Parker D. Trask. *Jour. Sedimentary Petrology*, vol. 9, no. 3, pp. 135-136, Dec. 1939.
Reviews the book (Trask, P. D., 6) treating the various parts separately. Notes the value of the book to students of the sediments.
 12. (and Tyler, S. A.). *Methods of study of sediments*. 183 pp., illus. New York, McGraw-Hill Book Co., Inc., 1941.
Considers methods of study of sediments. Evaluates and describes techniques. Takes up such subjects as field study of sediments, physical properties of sediments, chemical methods, collection of samples, mechanical analysis, separation of minerals, quantitative determination of mineral content, graphical representation, coals, mounting mineral grains, and thin sections. This work may serve as a laboratory manual for sedimentation studies.
 13. Soil - The most valuable mineral resource, its origin, destruction and preservation. *Oreg. Dept. Geol. and Min. Indus.*, Bul. 26, 45 pp., illus., 1944.
A detailed report on geologic processes involved in the formation and destruction of soil. Discusses in detail the formation of a rock mantle, rates of rock destruction, erosion of the rock mantle by water and wind, erosion in the United States, and the protection of lands against erosion. Gives considerable attention to the discussion of erosion, entrainment, transportation, and deposition of sediment. Discusses the effects of deposition on roads and railroads, channels, flood plains, and reservoirs.
 14. [Review of] The control of reservoir silting, by Carl B. Brown. *Jour. Sedimentary Petrology*, vol. 14, no. 1, pp. 39-40, Apr. 1944.
This review covers the more pertinent items brought forth by Mr. Brown's work (Brown, C. B., 21).
 15. [Review of] Micromeritics; the technology of fine particles, by J. M. Dalla Valle. *Jour. Sedimentary Petrology*, vol. 14, no. 2, p. 99, Aug. 1944.
Reviews a work (Dalla Valle, J. M., 2) which deals with small particles in the range from colloidal dimensions to sands and has a mathematical treatment.
 16. The rounding of sand grains. *Jour. Sedimentary Petrology*, vol. 15, no. 2, pp. 59-71, Aug. 1945.
Reviews the literature relating to the rounding of sand grains. Examines methods of transportation of sands in suspension and traction. Gives general conclusions concerning the problem.
- TYLER, E. See Richardson, E. G., 1.
TYLER, M. C.
1. Southwest Pass, Mississippi River, conclusions... relative to elimination of maintenance dredging. 12 pp. New Orleans, U. S. Engin. Off., 1932.
Believes bed load to be the main cause of shoaling at passes. Gives recommendation based on the consideration of South Pass as a full-scale model to eliminate the necessity of maintenance dredging at Southwest Pass.
- TYLER, R. G. See Taylor, T. U., 6.
TYLER, STANLEY A. See also Jackson, M. L., 1; Twenhofel, W. H., 12.
1. [Review of] Manual of sedimentary petrography, by W. C. Krumbein and F. J. Pettijohn. *Jour. Sedimentary Petrology*, vol. 9, no. 1, p. 42, Apr. 1939.
Reviews a book (Krumbein, W. C., 14) which is a comprehensive treatise on methods of petrographic analysis of sediments. Emphasizes the statistical and mechanical phases. The book deals with mechanical analysis, mineral, and chemical analysis of sediments. The reviewer believes the book should be condensed, but indicates that it is a valuable addition to the field of sedimentary petrography.
 2. [Review of] Sedimentary petrography, by Henry B. Milner. *Jour. Sedimentary Petrology*, vol. 11, no. 1, p. 46, Apr. 1941.
Discusses the book by Mr. Milner (Milner, H. B., 1). Recommends it as indispensable for those interested in sedimentary rocks. The book deals with sedimentary petrography and considers such subjects as laboratory technique, application of sedimentary petrography, and tables of minerals. Contains a selected bibliography of more than 800 items.
- UDDEN, JOHAN AUGUST.
1. The mechanical composition of wind deposits. Augustana Col. and Theological Seminary, Augustana Lib. Pubs., no. 1, 69 pp., illus., 1898.

A study of the mechanical composition of wind deposits and how it changes under varying conditions of deposition. This report probably introduces the first true geometric scale for soils and sediments, and is also one of the first works to use histograms. Notes that histograms vary considerably depending on the type of sediment involved. Gives a table showing approximate maximum distances over which quartz fragments of different dimensions may be lifted by moderately strong winds in single leaps.

2. Mechanical composition of clastic sediments. Geol. Soc. Amer., Bul., vol. 25, no. 4, pp. 655-744, tables, Dec. 1914.

Presents data on the mechanical analysis clastic sediments, and includes tables of mechanical analyses for till, water deposits, wind deposits, sands containing magnetite, loess, and gumbo. Notes that the modes of sorting or sedimentation in water are called drifting, silting and washing, and in air are called blowing, dusting and winnowing. Discusses the law of the sorting index. Gives a grade scale which has been extended to include coarser and finer sediments than given in the original scale.

UGUINCHUS, A. A.

1. On the design of non-silting canals. Sci. Res. Inst. Hydro-Technics, Trans., vol. 19, pp. 285-294, 1936. In Russian. Translation on file at the U. S. Soil Conservation Service, Washington, D. C., and University of Minnesota, Minneapolis, Minn.

A mathematical treatment concerned with the design of non-silting canals. Deals with various formulas such as those used by Lacey, Kennedy, Ganguillet-Kutter, and Chezy.

ULLYOTT, PHILIP.

1. Biological research in relation to water supply [abstract]. Water and Water Engin., vol. 37, no. 453, pp. 489-490, Sept. 1935.

Outlines the various physical and chemical factors affecting the properties of surface waters from a biological point of view. Notes effects upon plant life of suspended matter in the form of silt and dissolved material in the form of salts.

U. S. AMERICAN NATIONAL RED CROSS. See Red Cross. U. S. American National Red Cross.

U. S. BUREAU OF RECLAMATION. See also Federal Inter-Agency Sedimentation Conference; U. S. Federal Inter-Agency River Basin Committee; U. S. Interdepartmental Committee.

1. Bibliography on the subject of transportation of solids by flowing water in open channels. 2 pts. Denver, Colo., 1933.

A bibliography compiled with the objective of studying the silt and bed-load problem which is related to the design of the All-American Canal. Covers articles in the English literature and also articles of Swiss, French, and German writers. Some of the articles refer to closely related divisions of hydraulics such as scour at bends, river control, and turbulent flow theory. Consists of two parts: Pt. I lists by authors the different articles; Pt. II consists of a subclassification by subject.

2. Altus project--Oklahoma. 75th Cong., 3d sess., S. Doc. 153, 60 pp., illus., 1938.

Describes the Altus Irrigation Project, Red River Basin, Jackson and Greer Counties, near Altus, Okla. Includes four paragraphs presenting data on dissolved-load determinations for the North Fork, Elm Fork and Salt Fork, and determination of the rate of silting of the Altus Reservoir. Silt in the existing Altus Reservoir, 1927-37, amounted to 8,200 acre-feet for the 9-yr. period. The estimated life span of the proposed reservoir is calculated at 40 yr.

3. Model studies of Imperial Dam desilting works, All-American Canal structures. Boulder Canyon Project, Final Rpts., pt. 6, Hydraulic Invest., Bul. 4, 192 pp., illus., 1949.

Presents the results of model studies of the Imperial Dam, All-American Canal structures, and the desilting works to solve problems connected with design. Shows the general plan of the Imperial Dam desilting works. Includes a

chapter dealing with sediment problems of the reservoir and the All-American Canal head-works, problem of the All-American Canal desilting works, sediment scraper investigations, and study of influent slots.

4. Sedimentation report, or summary of sedimentation surveys of Buffalo Bill Reservoir, Shoshone Dam, Shoshone Project, Wyoming and Montana. 6 pp., illus., tables and graphs. [Denver, Colo., 1949.]

Presents information evaluated from surveys made in 1905 and 1941, including area-capacity curves, longitudinal profiles, area-capacity tables, and geologic and drainage area maps.

U. S. BUREAU OF RECLAMATION, OFFICE OF RIVER CONTROL, REGION III.

1. Tenth annual report on retrogression observations, salinity studies, and suspended load measurements--Colorado River Basin. 30 pp., illus., tables and graphs, Boulder City, Nev., 1945.

Report prepared by the Office of River Control of Region III during a transition period in the reorganization of the Bureau of Reclamation. Is a continuation of annual reports formerly issued from Denver under the general subject of retrogressions, salinity, and suspended sediment of the Colorado River. Data obtained in 1944 as well as data from previous years are considered. Gives data on bed material, salinity, suspended sediment, aggradation above Imperial Dam, etc.

2. Annual report of river control work and investigations, Lower Colorado River Basin, calendar year 1945. 44 pp., tables and graphs, Boulder City, Nev., 1946?

This is the second annual report prepared by the Office of River Control of Region III. Discusses meanders, erosion, sedimentation, suspended load, bed material, aggradation, evaporation losses, degradation, dissolved load, and runoff in the Colorado Basin. Various data pertaining to the above subjects are given.

U. S. CIRCUIT COURT.

1. Richardson et al v. United States (Circuit Court, Eastern Division, Virginia), March 14, 1900. Fed. Rptr., vol. 99, pp. 714-718, 1900.

Presents a legal report on the liability for damage to oyster beds in the York River, Va., caused by dredging a channel in the river as authorized by Congress for the improvement of navigation. Oysters were killed when the beds were covered with river silt both from the dredged channel and as a result of an upstream river control dike. The laws of Virginia under which the oyster-bed rights were granted are discussed and analyzed.

U. S. COAST AND GEODETIC SURVEY. See U. S. Federal Inter-Agency River Basin Committee.

U. S. CONGRESS, SENATE, COMMITTEE ON COMMERCE.

1. Cowan Creek Valley Dam, Clinton County, Ohio. Hearing, 75th Cong., 3rd sess., on S. J. Res. 244, May 17, 1938. 23 pp. Washington, 1938.

Presents the testimony given at a Senate Committee hearing relative to the proposed construction of the Cowan Creek Valley Dam, Clinton County, Ohio. Includes a discussion on the problems of silting in Cowan Creek behind the dam and means for its control. Notes briefly the condition of silting at Keokuk and O'Shaughnessy dams.

U. S. CONGRESS, SENATE, COMMITTEE ON IRRIGATION AND RECLAMATION.

1. Colorado River basin. Hearings, 68th Cong., 2d sess. 320 pp. Washington, 1925.

Includes statement and testimony by A. P. Davis (pp. 59-88) on the Swing-Johnson Bill for the construction of Boulder Dam, discussing the effect of river control by reservoirs upon the reduction of the amount of erosion in the Colorado River, the rate of filling of the proposed reservoir with sediment, the future raising of the dam, and the effect of the desilting of the Colorado River water at the proposed reservoir upon the regimen of the stream.

U. S. CORPS OF ENGINEERS. See U. S. Engineer Dept.

U. S. DEPT. OF AGRICULTURE. See also U. S. Interdepartmental Committee.

1. The Western Range. 74th Cong., 2nd sess., S. Doc. 199, 620 pp., 1936.

Deals with the preservation of satisfactory watershed conditions on range lands of the West. Seriousness of the erosion problem is due to mismanagement of range lands; silt and flood problems are due to conditions of erosion. Notes instances of accelerated erosion in mountain regions, in Colorado Plateau, in the Southwest, in northern desert valley lands, and on range lands of the Great Plains; causes of accelerated erosion; effects of accelerated erosion upon stream flow, stream and valley sedimentation, and the silting up of reservoirs; ownership or control of land as a contributing factor in accelerating runoff and erosion and in increasing the sediment content of streams; economic effects of accelerated runoff and erosion and increased silt production on soil fertility, irrigation water-supply improvement, floods, wildlife resources, etc.; and restoration of western range lands.

2. Survey report for the Los Angeles River watershed. 77th Cong., 1st sess., H. Doc. 426, 68 pp., illus., 1941.

Discusses recommendations for the Los Angeles River watershed, flood and erosion damages in the basin, existing and proposed flood-control work of all agencies, and the proposed program of the Department of Agriculture in aid to flood control which includes a plan for mountain roads and farm-land improvement and treatment. Analyzes costs, benefits, and supplemental aids to the program of the Department of Agriculture. A compilation of data on siltation of reservoirs in the basin and other data on sedimentation is included in the discussion of flood and erosion damages.

3. Survey of the Little Tallahatchie watershed in Mississippi. 77th Cong., 2d sess., H. Doc. 892, 74 pp., illus., 1942.

Presents a plan, based on a survey, for retardation of water flow and prevention of erosion in the Little Tallahatchie watershed in Mississippi as an aid to flood control. Gives flood and sedimentation damages.

4. Survey report on the Trinity River watershed. 77th Cong., 2nd sess., H. Doc. 708, 66 pp., illus., 1942.

Report of a survey of the Trinity watershed in Texas. Gives erosion, flood, and sedimentation damages, and recommends a program of water-flow retardation and soil-erosion prevention.

5. Potomac River drainage basin, Va., W. Va., Md. and Penn. 78th Cong., 1st sess., H. Doc. 269, 38 pp., illus., 1943.

Report of a survey of the Potomac River drainage basin in Virginia, West Virginia, Pennsylvania, and Maryland. Describes erosion, flood, and sedimentation damages. Recommends a program of water-flow retardation and soil-erosion prevention.

6. Survey of the Coosa River watershed in Georgia and Tennessee. 78th Cong., 1st sess., H. Doc. 236, 40 pp., illus., 1943.

Describes an investigation of a program of runoff, water-flow retardation, and soil erosion prevention in the aid of flood control. Proposes a program in aid of flood control for the Piedmont, foothill, and mountain areas of the Coosa watershed. Notes that the estimated future damage from sedimentation amounts to \$3,500 annually and mainly occurs in the Piedmont area. Points out that the estimated rate of sedimentation in the Allatoona Reservoir is very low. Discusses flood and erosion damages.

7. Watershed of the Little Sioux River. 78th Cong., 1st sess., H. Doc. 268, 24 pp., illus., 1943.

Summarizes the results of a survey conducted by the U. S. Department of Agriculture on the watershed of the Little Sioux River, Iowa and Minnesota. Comments on flood damages and erosion. Recommends a remedial program for abating the flood and related damages.

8. Survey of Buffalo Creek watershed in New York. 78th Cong., 2d sess., H. Doc. 574, 43 pp., illus., 1944.

Deals with the drainage area of Buffalo Creek in New York. This area has suffered damage from floods, erosion, and sedimentation. Discusses a remedial program and recommends a program to prevent losses. Comments on stream-bank erosion and stabilization. Notes deposition of sediment in Buffalo Harbor.

9. Survey of the Yazoo River watershed in Mississippi. 78th Cong., 2nd sess., H. Doc. 564, 58 pp., illus., 1944.

Presents a program of watershed treatments for the control of floods on valley lands. Includes measures to retard runoff and prevent soil erosion. Gives flood and sedimentation damages.

10. Survey report on Santa Ynez River watershed, California. 78th Cong., 2d sess., H. Doc. 518, 31 pp., illus., 1944.

Presents a survey report on the Santa Ynez River watershed in California. Recommends and describes the program of water-flow retardation and prevention of soil erosion in aid of flood control. Notes that denuding forest fires plus rain have resulted in annual sediment rates approximating 100 cu. yd. per sq. mile. Briefly considers sediment damages and the problem of reducing sedimentation in the Gibraltar and Juncol Reservoirs. Notes that the original capacity of Gibraltar Reservoir was 14,500 acre-feet and 20 yr. later, in 1940, the capacity was only 8,390 acre-feet.

U. S. ENGINEER DEPT. See also U. S. Federal Inter-Agency River Basin Committee; U. S. Interdepartmental Committee.

1. Report of the Secretary of War, communicating . . . a report and map of the examination of New Mexico, made by Lt. J. W. Abert. 30th Cong., 1st sess., S. Ex. Doc. 23, 132 p., 1848.

Gives an account of travelling in New Mexico. Various arroyos are described and streams are noted. A general description of the country in the years 1846-47 is given.

2. The improvement of the Des Moines and Rock Island Rapids of the Mississippi River. U. S. Engin. Dept., Rpt. 1867, pp. 264-361.

Deals with existing conditions of and proposed improvements to the Des Moines and Rock Island Rapids of the Mississippi River. Notes briefly the results of a suspended-load determination of Mississippi River water (Apr. 25, 1867) and discusses briefly the effect of bed-load movement upon bottom land banks of canals.

3. Improvement of rivers and harbors in Rhode Island and Connecticut. U. S. Engin. Dept., Rpt. 1868, pp. 745-803, 1869.

Presents various data relative to the improvement of rivers and harbors in Rhode Island and Connecticut. Includes three paragraphs briefly describing conditions of stream erosion and the transportation and deposition of silt by the Connecticut River.

4. Survey and improvements of the upper Mississippi, Minnesota and Wisconsin Rivers, and investigations relative to the bridging of the Mississippi and Ohio Rivers. U. S. Engin. Dept., Rpt. 1868, pp. 299-385, 1869.

Presents results of survey and improvements of the upper Mississippi, Minnesota, and Wisconsin Rivers, and investigations dealing with the bridging of the Mississippi and Ohio Rivers. Describes conditions of stream erosion and deposition in the harbor at Alton, Ill., near the confluence of the Mississippi and Missouri Rivers and proposed remedial works.

5. Improvement of the western rivers, except the Ohio River. U. S. Engin. Dept., Rpt. 1869, pp. 285-352, 1870.

Deals with existing and proposed improvements of the Mississippi, Missouri, and Arkansas Rivers. Includes discussion of General Roberts' plan to construct waste weirs along the Mississippi River in order to induce sediment deposition and reclaim alluvial lands bordering the stream. Presents data to prove the impracticability of the proposed plan.

6. Improvement of the mouth of the Mississippi. U. S. Engin. Dept., Rpt. 1870, pp. 326-377, illus.

U. S. ENGINEER DEPT. - Continued

- Deals with the progress of work and studies relative to the improvement of the mouth of the Mississippi River. Includes letters from Gen. Humphrey which discuss factors to be considered by Lyell in his computations of the age of the delta.
7. Fort St. Philip Canal and the construction of jetties for the improvement of the mouths of the Mississippi. U. S. Engin. Dept., Rpt. 1874, pt. 1, pp. 776-888.
Discusses the various aspects of the proposed Fort St. Philip ship canal and construction of jetties at the mouths of the Mississippi River for the maintenance of navigable depths. Details of existing conditions of erosion and deposition in the passes and at the mouths of the Mississippi are discussed. The effectiveness of the jetty system is considered.
8. Report on Mississippi River from Cairo to New Orleans. U. S. Engin. Dept., Rpt. 1875, pt. 2, pp. 496-521, 1876.
Presents results of a survey for the improvement of the Mississippi from Cairo to New Orleans. Discusses the regimen of western streams: characteristics of bed and banks, bank erosion, cut-off formation, conditions of sediment transportation and deposition, bed movement, character of deposits, laws governing flow of water and sediment, etc. Principles upon which improvement should be based are considered.
9. Survey of the Mississippi River between the mouths of the Illinois and Ohio Rivers. U. S. Engin. Dept., Rpt. 1875, pt. 2, pp. 471-495, 1876.
Presents results of a survey (1875) relative to the navigability of the Mississippi River between the mouths of the Illinois and Ohio Rivers. Includes a three-page discussion on the applicability of known theories on the transportation of sediment by flowing water to conditions of sediment transportation in the Mississippi River.
10. Improvement of the Ohio River. U. S. Engin. Dept., Rpt. 1876, pt. 2, pp. 3-24.
Reports progress of improvements on the Ohio River (1876). Discusses briefly conditions of deposition below Henderson dike due to the action of the river water in carrying gravel in suspension over the dike.
11. Improvement of the Sacramento and Feather Rivers, California. U. S. Engin. Dept., Rpt. 1879, pt. 2, pp. 1749-1761, illus.
Reports operations and results of a survey for the improvement of the Sacramento and Feather Rivers, Calif. (1879). Data on suspended sediment in the Sacramento River are given. Includes report of L. J. LeConte dealing with the level and movement of bed load of the Sacramento River under changing slopes, velocities, heights of floods, etc.
12. Results of sand wave and sediment observations on the Mississippi. U. S. Engin. Dept., Rpt. 1879, pt. 3, pp. 1963-1970, illus.
Presents results of observations (Mar. 10-June 23, 1879) on the character of sand waves and sediment load of the Mississippi River at Helena, mean velocity and discharge of the river, river slope, and gauge readings. Methods of sediment observation and sampling equipment are described.
13. Survey of the Mississippi River. U. S. Engin. Dept., Rpt. 1879, pt. 3, pp. 1922-1929.
Presents results of a survey of the Mississippi River (1878-79). Data are given on a suspended-sediment determination of river water from Austin to the delta near Bennett's Landing and Commerce (Dec. 13, 1878-Mar. 6, 1879), and size distribution of particles in sediment samples.
14. Preliminary report upon the improvement of the navigation of the Missouri River. U. S. Engin. Dept., Rpt. 1881, pt. 2, pp. 1649-1659.
Describes the improvement of the navigability of the Missouri River by the War Department. Notes that 5 508,229,008 cu. ft. of suspended sediment and an equal amount of bottom material were carried past St. Charles station in 1879. Caving banks form the chief source of suspended material. Bars are the main obstacle to navigation; their formation, influence on river regimen, and the effect of localized systems of channel improvement, designed to cause removal of bars by concentrating the scouring action of water on them, are discussed. Recommends that the high-water width of the river be decreased for 800 miles from the mouth of the river to Sioux City, Iowa, to cause uniform silt deposition in this section, and describes the plan in detail.
15. Tidal area of San Francisco Bay. U. S. Engin. Dept., Rpt. 1881, pt. 3, pp. 2515-2524.
Reports an investigation to determine the cause tending to diminish the tidal area of San Francisco Bay. Surveys indicate deposits of 76,025,000 cu. yd. of sediment in San Pablo Bay between 1855 and 1887. Surveys of 1868 and 1878 show heavy residual sedimentary deposits at mouths of the Sacramento and San Joaquin Rivers. Deposits, when above low-water, shut out an equivalent volume of tide.
16. Protection of the navigable waters of California from injury from the debris of mines. U. S. Engin. Dept., Rpt. 1882, pt. 3, pp. 2543-2636.
Discusses methods for the control of hydraulic-mining debris in California. Stresses the importance to navigation of the mining-debris problem, compares data on land-surface reduction in the Sacramento and San Joaquin basins with data on natural denudation in other river basins of the world. Conditions of debris deposition on beds and adjoining alluvial lands of the Yuba, Bear, and American Rivers and tributaries of the Feather and Sacramento Rivers are described.
17. Improvement of St. John's River, Florida. U. S. Engin. Dept., Rpt. 1889, pt. 2, pp. 1298-1308, illus.
Reports progress in the construction of the jetties at the mouth of the St. John's River to June 30, 1889. Included are results of density and sediment observations taken at the mouth of the river (June 1889). Sampling method and apparatus are briefly described.
18. Report of Assistant Engineer H. M. Marshall, June 10, 1893. U. S. Engin. Dept., Rpt. 1893, pt. 3, pp. 1925-1999, illus.
Presents results of a hydrographic survey of the Red River in Louisiana and Arkansas. Data are given on sediment in the Red River, Fulton, Ark., to the head of Atchafalaya River, La.
19. Report of Assistant Engineer H. H. Marshall, June 18, 1894. U. S. Engin. Dept., Rpt. 1894, pt. 3, pp. 1439-1452, illus.
Presents results of a hydrographic survey of the Red River in Louisiana and Arkansas. Gives results of sediment observations in the Red River from Fulton, Ark., to the head of the Atchafalaya River, La.
20. Inspection of the improvement of the South Pass of the Mississippi River. U. S. Engin. Dept., Rpt. 1896, pt. 3, pp. 1471-1484, illus.
Reports improvements to and observations at the South Pass of the Mississippi River. Data are given on current velocity, ratio of sediment to water by weight, and ratio of sand to water by weight at Port Eads for the period, January 1890-June 1896.
21. Survey of Christiana River and Wilmington Harbor, Delaware, with a view of obtaining a depth of 21 feet. U. S. Engin. Dept., Rpt. 1896, pt. 2, pp. 978-992.
Presents results of a survey on the Christiana River and at Wilmington Harbor, Del., with a view to the construction of a 21-ft. channel. Results of suspended-sediment observations taken at sampling stations on the stream and on Brandywine Creek (Apr. 19, 1895) are given and discussed. Considers the physical characteristics of the matter obtained in the Christiana River. Estimates the extent of annual shoaling in the stretch under consideration.
22. Sediment observations in Ouachita and Black Rivers, Arkansas and Louisiana. U. S. Engin. Dept., Rpt. 1902, pt. 2, p. 1559.
Table 9 presents results of sediment observations at various points in the Ouachita and Black Rivers in Arkansas and Louisiana, on scattered days during 1891, 1893, 1895-1897.

23. Discharge and sediment observations in Grand, Cuyahoga and Black Rivers. U. S. Engin. Dept., Rpt. 1904, pt. 4, pp. 3813-3818, illus.
Presents results of runoff, rainfall, and sediment observations (October 1901-June 1904) in the Grand, Cuyahoga, and Black Rivers, Ohio.
24. Report by a Special Board of Engineers on survey of Mississippi River from St. Louis, Mo., to its mouth with a view to obtaining a channel 14 feet deep and of suitable width. 61st Cong., 1st sess., H. Doc. 50, 532 pp., illus., 1909.
Reports a survey of the Mississippi River from St. Louis to the mouth with a view to obtaining a channel 14 ft. deep throughout. Describes the physical characteristics of the Mississippi River. Deals with bank erosion, bank protection, formation of river bars, rise and fall of river bed during changes of water stage, and erosion of banks. Includes various hydrologic data for the river.
25. San Carlos Irrigation Project, Arizona. 63d Cong., 2d sess., H. Doc. 791, 168 pp., illus., 1914.
Presents results of investigations by a Board of Engineer Officers, U. S. Army, dealing with the various engineering aspects of the San Carlos Irrigation Project in Arizona. Includes a detailed discussion on the sediment-load determination of the Gila River, volume-weight determination of deposited silt, estimated rate of silting of the San Carlos reservoir, provision for additional storage capacity to impound silt in the reservoir and to postpone desilting operations, and fertility of Gila River silt. Notes briefly data on silt in the Rio Grande. Considers various methods for the desilting of the San Carlos Reservoir. Presents an analysis of all available data to determine the amount of silt that would be deposited in a reservoir at San Carlos and means for its disposal.
26. Savannah Harbor, Georgia, from foot of Kings Island to the sea. 69th Cong., 1st sess., H. Doc. 262, 91 pp., illus., 1926.
Presents results of a study relative to existing conditions of and proposed improvements to navigation in Savannah Harbor, Ga., from Kings Island to the sea. Includes data (pp. 39-40) on a method of collecting samples for silt and salinity determinations, and on silt determinations, rate of settling, and effect of salinity upon conditions of sediment deposition and transportation in the harbor.
27. Hydraulic mining investigations in California. 70th Cong., 1st sess., S. Doc. 90, 31 pp., illus., 1928.
Presents results of investigations by the California Debris Commission relative to the construction of debris dams on the Yuba, Bear, and American Rivers in California. Includes discussions on the character of debris to be stored, movement, conditions of deposition in reservoirs, final surface slope of debris in reservoirs, dam design and costs, and storage space of reservoirs to be occupied by non-mining detritus.
28. Iowa River, Iowa and Minnesota. 71st Cong., 2nd sess., H. Doc. 134, 166 pp., illus., 1930.
Deals with various aspects relative to existing conditions and proposed improvements to navigation, irrigation, water power, and flood control on the Iowa River in Iowa and Minnesota. Includes a brief discussion on silt carried by the stream. A table is given of measurements of suspended silt in the stream at Iowa City. Notes that the major portion of silt transported by the stream is deposited in and above Keokuk reservoir, bottom-land deposits cause little damage and occasionally are beneficial, and proposed flood-control reservoirs and forestation of banks and bottom lands would reduce the erosional debris load.
29. Tennessee River and tributaries, North Carolina, Tennessee, Alabama and Kentucky. 71st Cong., 2nd sess., H. Doc. 328, 734 pp., illus., 1930.
Deals with various aspects of existing conditions and proposed improvements to navigation, irrigation, water power and flood control on the Tennessee River and its tributaries in North Carolina, Tennessee, Alabama, and Kentucky. Damages from erosion and silting in the Tennessee basin are insignificant. The total dissolved and suspended materials equal a land surface reduction of approximately 0.001872 in. yearly. Flood waters of the Tennessee annually contribute 3,582,000 cu. yd. of suspended material to the Mississippi. Planned development of the Tennessee and its tributaries will result in clarifying the water during low flow, but will increase the suspended load during floods; the net annual load will be the same. Soil erosion prevention measures will aid agriculture but have little effect on stream flow.
30. Des Moines River, Iowa. 71st Cong., 3rd sess., H. Doc. 682, 127 pp., illus., 1931.
Deals with navigation, irrigation, flood control, and water power on the Des Moines River, Iowa. Briefly notes the river bank protection afforded by levees at the mouth of the Des Moines River, between the mouth and Ottumwa, and at Ottumwa. The Des Moines River carries an average suspended load of 642 parts per million or 5,000,000 tons annually; a table of suspended solids in the Des Moines and Racoon Rivers is given. Erosion of the Des Moines River banks is not serious and deposition of silt has increased fertility of the bottom land. The silt load carried into the Mississippi by the Des Moines has a negligible effect on the regulation of the Mississippi above the mouth of the Missouri.
31. Meramec River, Mo. 71st Cong., 3rd sess., H. Doc. 686, 84 pp., illus., 1931.
Deals with improvements to navigation, flood control, and water power on the Meramec River in Missouri. Discusses the history of developments on the river, physical and economic watershed conditions, flood control, and navigation improvements. Considers the effect of slack-water improvement on erosion and siltage, storage water usage, and the effect of returned flow on erosion and siltage. States that silting of reservoirs on the Meramec and its tributaries is a minor problem. The importance of reservoir silting is indicated by the reduction in the capacity of the reservoir at Austin, Tex. by 1/2 in 7 yr. Quotes and makes reference to Buckley, Gilbert, Meyer, Hooker, and others relative to the occurrence and prevention of reservoir silting. States that predetermination of the rates of reservoir silting is difficult. Factors influencing the sediment load of streams and its rate of travel, and those upon which the probable rate of silting of a reservoir is dependent are given. Presents a coordinated plan of development and economic considerations.
32. Tar River, N. C. 72d Cong., 1st sess., H. Doc. 187, 115 pp., illus., 1931.
Reports existing conditions and proposed improvements to navigation, flood control, and water-power developments of the Tar River, N. C. Includes four paragraphs briefly commenting on conditions of silt deposition in the stream. Deforestation and the character of watershed soils are responsible for silt deposits. The amount of silt carried by the Tar River is estimated at 200 p. p. m., based on determinations on the Ocmulgee River at Macon, Ga. which carries an average of 174 p. p. m. in suspension and the Savannah River at Augusta, Ga. which carries an average of 142 p. p. m. Silting conditions in the proposed reservoirs for power development and flood control are considered. Cites the case of the reservoir at Austin, Tex. which silted 75 percent after 10 yr. of operation.
33. Big and Little Sioux Rivers, Iowa and South Dakota. 72d Cong., 1st sess., H. Doc. 189, 114 pp., illus., 1932.
Deals with present conditions and proposed improvements to the Big and Little Sioux Rivers in Iowa and South Dakota. Notes that erosion in drainage ditches in the Little Sioux basin has resulted in silting of the river channel; the reduced capacity of the channel causes serious floods. The plan of improvement includes cleaning the Monona-Harrison ditch, channel enlargement, construction of laterals, and

- closing of the Equalizer ditch. The estimated cost is given.
34. Cheyenne River, S. Dak. and Wyo. 72d Cong., 1st sess., H. Doc. 190, 277 pp., illus., 1932.

Deals with existing conditions of and proposed improvements to navigation, flood control, water-power development, and irrigation in the Cheyenne River basin in South Dakota and Wyoming; extent of bank erosion and silt conditions in the stream; silt content determinations at Evans Quarry (May 30, 1929); and at Elwood (August, September 1929); quality of irrigation or water-power projects on conditions of navigation and bank erosion in the Missouri River; and the stabilizing effect of return flow of irrigation waters as a means of preventing erosion and siltage or improving navigation in the Cheyenne, Missouri, and Mississippi Rivers. Results of analyses of silt samples taken from the Cheyenne River at various points and various dates are given.
35. Gasconade River, Mo. 72d Cong., 1st sess., H. Doc. 192, 156 pp., illus., 1932.

Deals with existing conditions of and proposed improvements to irrigation, navigation, flood control, and water-power developments in the Gasconade River, Mo. Includes discussions on the extent of bank erosion along the river, the quantity and characteristics of the suspended sediment transported, the reservoir silting problem, and the effect of stabilization of flow due to reservoir construction in the Gasconade upon conditions of erosion and siltage in the Gasconade, Missouri, and Mississippi Rivers. Presents data on suspended-sediment discharge of the Gasconade River at Rich Fountain (July 1929-May 1930), mechanical analyses of suspended sediment, character of bed material and effect of bed-material movement on siltation conditions in proposed reservoirs. The annual suspended-load discharge of the Gasconade is estimated at 200 acre-feet.
36. Grand River, Missouri and Iowa. 72d Cong., 1st sess., H. Doc. 236, 1935 pp., illus., 1932.

Deals with existing conditions of and proposed improvements to navigation, irrigation, flood control, and water-power developments on the Grand River in Missouri and Iowa, and the extent of bank erosion along the Grand River. Investigations relative to the quantity and character of bed and suspended sediment were made on the Grand at Summer (July 12, 1929-June 11, 1930) and on the Grand at Gallatin and the Thompson at Trenton (April 11-July 15, 1930). Compares suspended-sediment discharge past various stations on the Grand River and past Kansas City on the Missouri River, relative quantities of suspended sediment transported by the Grand and Missouri Rivers (July 12, 1929-June 11, 1930), and variation in suspended sediment transported by the respective streams. Presents data relative to the mechanical nature of the suspended sediment of the Grand River compared to that of the Missouri. The average annual silt discharge of the Grand River is estimated at 7,500 acre-feet. Estimates the rates of silting of proposed reservoirs. Reports conditions of sedimentation at existing channel-straightening works for flood control, failure of improvement works, proposed levee and reservoir construction for flood control, and effect of reservoir flood control on the hydraulics of the Missouri and Mississippi Rivers.
37. Housatonic River. 72d Cong., 1st sess., H. Doc. 246, 85 pp., illus., 1932.

Deals with existing conditions of and proposed improvements to navigation, flood control, power development, and irrigation in the Housatonic River basin. Includes a brief discussion on the silting of reservoirs in the basin, stating that silting of reservoirs, in general, in the Housatonic basin would be so slight as to require no serious consideration.
38. Improvement and development of the Neuse River, N. C. 72d Cong., 2d sess., H. Doc. 500, 101 pp., illus., 1932.

Deals with existing conditions of proposed improvements to navigation, irrigation, flood control, and water-power developments on the Neuse River in North Carolina. Presents data on annual silt yield of southeastern rivers, volume-weight determinations of deposited silt, factors affecting the sediment load of streams, and estimated bed load of the Neuse River. Describes various features of proposed power projects in the Neuse River basin, and gives estimated rates of silting.
39. Lehigh River, Pa. 72d Cong., 1st sess., H. Doc. 245, 49 pp., illus., 1932.

Deals with existing conditions of and proposed improvements to navigation, flood control, and power developments of the Lehigh River, Pa. Includes one paragraph noting that little evidence of erosion in the upper Lehigh watershed justifies an estimate that the rate of silting of storage reservoirs would not exceed 20 percent in a century; Kensico Lake, N. Y., lost 3 percent of its capacity by silting in 23 yr. (1884-1907). However, any reservoir on the Lehigh or its tributaries below culm deposits would silt more rapidly.
40. Manistee River, Mich. 72d Cong., 1st sess., H. Doc. 159, 51 pp., illus., 1932.

Deals with existing conditions of and proposed improvements to navigation, irrigation, flood control, and water-power developments on the Manistee River, Mich. Includes a brief discussion on the problem of reservoir silting. Describes briefly conditions of deposition and erosion in the stream due mainly to logging operations conducted on the river, the lower portion of the stream having filled 5-8 ft. in depth since 1850. Notes that Stronach Dam has been almost completely silted since its completion in 1912, but the pool above Junction Dam shows no extensive shoaling during 12 yr. of operation. The proposed storage at Portage Lake, Hayes Reservoir, and at Walton would not be seriously affected by silting. Completion of all dams will reduce most of the river to slack-water flow during floods and thereby eliminate the silt problem.
41. Mayfield Creek, Ky. 72d Cong., 1st sess., H. Doc. 156, 20 pp., illus., 1932.

Deals with existing conditions of and proposed improvements to flood control in the Mayfield Creek basin in Kentucky. Flood damages to crops are small; some landowners value flooding of their land because of deposits of soil-enriching silt. Existing flood control works consist of channel straightening and enlargement and substitution of dredged ditches for original channels. Conditions of erosion and deposition in ditches and the stream channel and plans for future flood control are described.
42. Muskegon River, Mich. 72d Cong., 1st sess., H. Doc. 143, 55 pp., illus., 1932.

Deals with present conditions of and proposed improvements to navigation, irrigation, water power, and flood control on the Muskegon River, Mich. Conditions of transportation and deposition of sediment in the stream are briefly described. Deposits above the dam at Newaygo amounted to 7-8 ft. in about 30 yr.; the low rate of silting probably is due to construction of the Croton Dam 13 miles upstream. Comments upon silting conditions at Houghton Lake and the estimated rate of silting of the proposed Leota and Temple Reservoirs. States that completion of dams will reduce the transporting power of streams thereby reducing the silt problems.
43. Musselshell River, Mont. 72d Cong., 1st sess., H. Doc. 146, 74 pp., illus., 1932.

Deals with existing conditions of and proposed improvements to navigation, irrigation, flood control, and water-power developments of the Musselshell River, Mont. Includes a brief discussion on silt and sediment in the stream, stressing the seriousness of the bank erosion problem. Notes that the silt load is heavy during short high-water periods, but that definite determinations await results of a silt study.

Notes that reservoir silting is prevented since the projects are located in the headwaters or are supplied by canals from which silt must necessarily be excluded.

44. Puyallup River, Wash. 72d Cong., 1st sess., H. Doc. 153, 45 pp., illus., 1932.

Deals with present conditions and proposed improvements to navigation, irrigation, water power, and flood control on the Puyallup River, Wash. Notes the extent of silting in the Puyallup waterway, Tacoma, (1909) and improvements to White, Stuck, and Puyallup Rivers for flood control (1914-19). Melting Mt. Ranier glaciers swell the Puyallup and its tributaries with torrents of liquid mud carrying cobbles and boulders during June, July, and August, when the sediment load averages 2-10 percent by weight. Silting of reservoirs would be a serious problem. Notes means of controlling sediment at the Election development on Puyallup River by use of a settling basin and forebay and at the storage reservoir at Kapowsin Lake by diversion. Silting of the proposed reservoir on Greenwater River would not be serious. The flood of 1906 in the Puyallup valley caused serious damage. Conditions of erosion and the deposition of sand, silt, and debris are described. Satisfactory protection was afforded by the subsequent construction of barriers, cut-offs, levees and other engineering improvements.

45. Skunk River, Iowa. 72d Cong., 1st sess., H. Doc. 170, 110 pp., illus., 1932.

Deals with conditions of and proposed improvements to navigation, irrigation, water-power developments, and flood control on the Skunk River, Iowa. Includes a brief discussion on erosion and siltage. Compares relative suspended loads of the Skunk, Iowa, and Des Moines Rivers. States that bank protection is not necessary in the stream. Notes the effect of silt deposition upon the fertility of bottom lands.

46. Survey of Mississippi River between Missouri River and Minneapolis. 72d Cong., 1st sess., H. Doc. 137, pt. I, 120 pp., illus., 1932.

Presents results of a survey conducted to determine means of securing a channel depth of 9 ft. at low water with suitable widths in the section of the Mississippi River between the Missouri River and Minneapolis. Includes a discussion on proposed reservoirs in the section. Results of surveys on conditions and effects of silting in existing Lakes Keokuk and Pepin are described. Considers bottom conditions in Lake Keokuk, characteristics of silt deposit, distribution of silt deposits, effect of deposits on plant and animal life, and conditions in Lake Pepin with reference to plant and animal life.

47. Columbia River and minor tributaries. 73d Cong., 1st sess., H. Doc. 103, 1845 pp., illus., 1933.

Presents results of comprehensive studies relative to existing conditions of and proposed improvements to power developments, navigation, irrigation, and flood control on the Columbia River and its minor tributaries. Report includes a brief summary of turbidity investigations at the City of Wenatchee (January 1927-November 1930) indicating that the silting of any reservoirs constructed on the Columbia above the mouth of Snake River will be negligible. Describes characteristics of silt at the proposed Grand Coulee Dam site, noting in particular conditions of permeability; floods and flood damages; bank erosion and bank protection.

48. Cumberland River, Kentucky and Tennessee. 73d Cong., 1st sess., H. Doc. 38, 86 pp., illus., 1933.

Deals with existing conditions of and proposed improvements to navigation, flood control, and power developments of the Cumberland River in Kentucky and Tennessee. Includes a brief discussion on the effect of proposed reservoirs on erosion and siltage, noting that watershed and river-bank erosion and siltage are not serious problems in the Cumberland basin. A system of power reservoirs would retain a

large portion of the silt now moving into the Ohio River both as suspended and bed load. Siltage in the existing Great Falls Reservoir has averaged 0.05 ft. per year.

49. Green, Barren, and Rough Rivers, Ky. 73d Cong., 1st sess., H. Doc. 81, 67 pp., illus., 1933.

Deals with existing conditions of and proposed improvements to navigation, water-power developments, irrigation, and flood control of the Green, Barren, and Rough Rivers in Kentucky. Investigations indicate that proposed reservoirs would control about 1/2 of the Green River drainage. Estimates the maximum annual sediment deposit they could receive at 300,000 cu. yd., removable from present channels at a cost of \$75,000. Construction of considered reservoirs would neither save money nor prevent erosion. Gives results of studies to determine the amount of sedimentation above navigation dams Nos. 1, 3, and 5 on the Green River and No. 1 on the Barren River.

50. Kentucky River, Kentucky. 73d Cong., 1st sess., H. Doc. 85, 72 pp., illus., 1933.

Deals with existing conditions of and proposed improvements to navigation, irrigation, flood control, and water-power developments on the Kentucky River in Kentucky. Includes a brief discussion on the silting of reservoirs on the Kentucky River and its tributaries. Data are given on the extent of material dredged from pools above navigation Locks 1-14 for the fiscal years 1910-30, inclusive, also on conditions of silt deposition in the Dix River Reservoir.

51. Little Missouri River, Wyo., Mont., S. Dak., and N. Dak. 73d Cong., 1st sess., H. Doc. 64, 90 pp., illus., 1933.

Deals with existing conditions of and proposed improvements to navigation, flood control, irrigation, and water-power developments on the Little Missouri River in Wyoming, Montana, South Dakota, and North Dakota. Includes discussions on bank erosion and silt in the stream and on the silting of potential reservoirs. Bank erosion in the Little Missouri River basin is moderate. The estimated average annual suspended-sediment discharge of the Little Missouri is 8,600,000 tons (Oct. 1, 1921-Sept. 30, 1931), fineness of particles contributed to the Missouri facilitating transportation in suspension without appreciable deposition. Discusses the relationship of sediment discharge of the Little Missouri past Medora and of the Missouri past Kansas City; the character of suspended sediment (mechanical analysis); and the character of bed sediment and extent of bed movement. The proposed Cottonwood Creek Reservoir would silt up in 41 yr. and Bullion Butte Reservoir in approximately 58 yr.; need for desilting works is indicated.

52. Milk River, Montana. 73d Cong., 1st sess., H. Doc. 88, 237 pp., illus., 1933.

Deals with existing conditions of and proposed improvements to navigation, irrigation, flood control, and water-power developments on the Milk River in Montana. Discusses extent of bank erosion, investigations to determine amount and character of sediment transported by the Milk River at Nashua and Havre (Jan. 12, 1930-Aug. 31, 1931), a comparison of the suspended sediment discharge on the Milk River at Havre and at Nashua, and damages by sediment deposited during high-water periods, ranging up to a depth of 2 ft. on farm lands in the river valley. Compares the amount of sediment transported by the Milk River past Nashua and the Missouri River past Kansas City (Apr. 8, 1930-Aug. 31, 1931), the relative quantity of solid material transported away from drainage areas of the Milk River above Nashua and above Havre, and the relation of sediment discharge and average erosion of the Milk and Missouri River basins. Reports the character of bed and suspended sediment in the Milk River (mechanical analysis), compared with that of the Missouri River; bed-load movement; computations to determine anticipated rate of silting in several proposed reservoirs in the Milk River basin; volume weight determina-

- tions of deposited silt; conclusions drawn from silt studies; and benefits to navigation and agriculture resulting from proposed measures to prevent silt and erosional debris from entering the stream.
53. Report on hydraulic study for eliminating maintenance dredging in Southwest Pass. 110 pp. New Orleans, 1933.
Believes bed load to be the chief cause of shoaling in Southwest Pass, and presents conditions necessary to eliminate maintenance dredging. Notes that further contraction of Southwest Pass will produce better results.
 54. Santee River, N. C. and S. C. 73d Cong., 1st sess., H. Doc. 96, 153 pp., illus., 1933.
Deals with existing conditions of and proposed improvements to navigation, irrigation, flood control and water-power developments in the Santee River basin in North and South Carolina. Includes a discussion on the silting of reservoirs. Presents tabulated data on silt deposition in various reservoirs and rivers in the United States. Results and conclusions from field investigations on silt deposits at four existing power plants in the Santee and Yadkin-Pee Dee River basins are given. Estimates the life of the Santee River proposed reservoirs.
 55. Warrior and Tombigbee Rivers and tributaries, Ala. and Miss. 73d Cong., 1st sess., H. Doc. 56, 497 pp., illus., 1933.
Deals with existing conditions of and proposed improvements to navigation, irrigation, flood control, and water-power developments on the Warrior and Tombigbee Rivers and their tributaries in Alabama and Mississippi. Describes Warrior River improvement works, noting their effect upon reduction in flood heights which results in bank-erosion control and reduction of cost of maintenance at locks because of sand and debris deposition. Probable silting in the proposed impounding reservoirs on tributaries of the Warrior River is estimated by comparison with silting data at existing Dam No. 17 together with available data on silting conditions in the Medina River and Medina Reservoir of Texas, comparison of conditions conducive to erosion in the Warrior and Medina river basins, and rates of silting in existing Medina Lake and Bankhead Lake above Navigation Dam No. 17, and in proposed impounding reservoirs on tributaries of the Warrior River. Existing improvement works on the Tombigbee River and its tributaries are described, including conditions of bank erosion and the deposition of silt in the stream and at navigation locks and dams, problems of maintenance, and proposed remedial measures.
 56. White River, Missouri and Arkansas. 73d Cong., 1st sess., H. Doc. 102, 462 pp., illus., 1933.
Deals with existing conditions of and proposed improvements to navigation, irrigation, flood control, and water-power developments of the White River in Missouri and Arkansas. Includes results of silt determinations (February-April 1931) at Black Rock on the Black River and at DeValls Bluff on the White River. The average silt content (percent by weight) at Black Rock was 0.0127 and at DeValls Bluff, 0.0148. White River is classified as a clear-water stream.
 57. Yadkin-Pee Dee River, N. C. and S. C. 73d Cong., 1st sess., H. Doc. 68, 132 pp., illus., 1933.
Deals with existing conditions of and proposed improvements to navigation, irrigation, flood control, and water-power developments on the Yadkin-Pee Dee River in North and South Carolina. Includes data on the silting of existing and proposed reservoirs. Presents data on siltation rates in various rivers and reservoirs (siltation rate reduced to unit of acre-feet per 100 sq. miles of drainage area per annum). Results of silt investigations (August 1930 and April 1931) at sites of existing power plants in the Santee and Yadkin-Pee Dee river basins are considered, giving computations of total silt deposit and amount of deposit in operating draw down of plants. Data are given for the Coolee-mee, Blewett Falls, Lookout Shoals, Wateree plant, and Bridgewater Reservoir. Characteristics and distribution of silt in Bridgewater Reservoir are noted. The average rate of siltation in reservoirs of the Yadkin-Pee Dee basins is estimated at 13 acre-feet per 100 sq. miles of drainage area per annum. Estimates the life of proposed reservoirs.
 58. Cannonball, Grand, and Moreau Rivers, North Dakota and South Dakota. 73rd Cong., 1st sess., H. Doc. 76, 89 pp., illus., 1934.
This report deals with existing conditions of, and proposed improvements to irrigation, flood control, and water-power developments of the Cannonball, Grand, and Moreau Rivers in North Dakota and South Dakota. Notes extent of bank erosion and bed scour in the streams. Data are given on results of silt sampling on the Cannonball River at Timmer, N. Dak. (Apr. 6-July 31, 1931), on the Grand River at Wakpala, S. Dak. (Mar. 1-July 31, 1931), and on the Moreau River at Promise, S. Dak. (Feb. 8-July 31, 1931). Presents comparisons of suspended-sediment discharges of the streams at the localities noted with the Missouri River at Kansas City and comparisons of suspended matter transported by the Missouri River and the streams. Results of an investigation relative to the character of bed and suspended sediment carried by the Cannonball, Grand, and Moreau Rivers are given. Data pertaining to the silting of reservoirs in the stream basins are discussed.
 59. Cape Fear River, North Carolina. 73d Cong., 2d sess., H. Doc. 193, 117 pp., illus., 1934.
Deals with existing conditions of and proposed improvements to navigation, irrigation, flood control, and water-power developments of the Cape Fear River in North Carolina. Includes discussion on conditions of erosion and runoff in the Cape Fear River watershed. Gives summary of results of suspended silt determinations of the southeastern river (1906-07); volume-weight determinations of deposition silt; and annual yields of suspended silt per square mile of drainage area. Based on annual silt yield of 0.25 acre-feet per annum per square mile of Cape Fear River drainage area, data are given on anticipated rates of silting of proposed power and flood control projects.
 60. Delaware River. 73d Cong., 2d sess., H. Doc. 179, 174 pp., illus., 1934.
Deals with existing conditions of and proposed improvements to navigation, irrigation, flood control, and water-power developments in the Delaware River basin. Includes a brief discussion on the life of the proposed reservoirs in the basin, noting that silting is not an important factor in connection with the reservoirs considered.
 61. Eel River, California. 73d Cong., 2d sess., H. Doc. 194, 50 pp., illus., 1934.
Deals with existing conditions of and proposed improvements to irrigation, navigation, flood control, and power developments on the Eel River, Calif. Discusses, in connection with flood control, floods, and flood damages in the Eel River delta, channel meandering, bank cutting, and erosion and deposition of drift. A plan of protection against floods is briefly described. Discusses the economic value of stream stabilization. Notes that frequent overflows in the delta contribute deposits of silt which maintain the fertility of the soil.
 62. James River, North Dakota and South Dakota. 73d Cong., 1st sess., H. Doc. 83, 130 pp., illus., 1934.
Deals with existing conditions of and proposed improvements to navigation, irrigation, flood control, and water-power developments on the James River in North Dakota and South Dakota. Includes a discussion on the extent of bank erosion and silt conditions in the stream. Results are briefly given of an investigation (Aug. 18-Nov. 20, 1939) on the quantity and nature of sediment transported. Compares data on silt concentration in the James River at Scotland with that of the Missouri River at Kansas City.

63. James River, Va. 73d Cong., 2d sess., H. Doc. 192, 61 pp., illus., 1934.
Deals with existing conditions of and proposed improvements to navigation, flood control, and water-power developments on the James River in Virginia. Includes one paragraph noting that the stream carries annually about 364,000 tons of dry silt which is deposited in the estuary and which involves periodic dredging. The effect of silt upon the life of proposed reservoirs is briefly noted.
64. Mad River, Calif. 73d Cong., 2d sess., H. Doc. 188, 40 pp., illus., 1934.
Deals with existing conditions of and proposed improvements to navigation, water-power developments, and flood control on the Mad River in California. Notes that serious flood damage in the Mad River drainage basin is infrequent, except on about 6,000 acres of fertile delta land where floods 2-10 ft. deep cause land erosion, washouts, and deposition of debris. Bank revetment and willow planting offer the most effective protection; retention reservoirs are not feasible. The cost of channel rectification would exceed the average annual flood damage of \$7,000. Continuation of bank protection works is recommended for flood control on the Van Duzen River.
65. Niobrara River, Nebr. and Wyo. 73d Cong., 1st sess., H. Doc. 90, 105 pp., illus., 1934.
Deals with existing conditions of and proposed improvements to navigation, irrigation, flood control, and water-power developments of the Niobrara River in Nebraska and Wyoming. States that data on existing water-power plants indicate complete silting within 20 yr. of any reservoir on the Niobrara having a capacity of less than 50,000 acre-feet; the extent of bank erosion on the stream is of little importance. Gives results of field investigations (July 26, 1929-Nov. 30, 1930) at Verdel, Nebr., to determine the nature and quantity of suspended sediment in the Niobrara River and the daily suspended sediment discharges. Compares suspended sediment at Verdel on the Niobrara and at Kansas City on the Missouri. Describes silt characteristics (mechanical analysis) of suspended sediments of the Niobrara and Missouri Rivers, silting of existing reservoirs at Valentine and Spencer, Nebr., and silting conditions and remedial measures at the proposed Meadville and Arabia power projects.
66. Osage River, Mo. and Kans. 73d Cong., 1st sess., H. Doc. 91, 157 pp., illus., 1934.
Deals with existing conditions of and proposed improvements to navigation, irrigation, flood control, and water-power developments on the Osage River in Missouri and Kansas. Includes data on the extent of bank erosion and sediment transportation on the Osage River, and nature and quantity of transported sediment. Compares suspended-sediment concentration, characteristics of the suspended sediment, and the average bed sediment of the Missouri and Osage Rivers. Discusses rate of silting and distribution of sediment in the reservoir area of existing Lock and Dam No. 1 on the Osage River and the probable effect of reservoirs on the stream upon the deposition of sediment; dredging on the Osage River; and plan of development on the Osage River to increase navigable depths between Lock and Dam No. 1 and mouth of stream.
67. Platte River, Colo., Wyo., and Neb. 73d Cong., 2d sess., H. Doc. 197, 533 pp., illus., 1934.
Deals with existing conditions of and proposed improvements to water-power developments, navigation, irrigation, and flood control of the Platte River in Colorado, Wyoming, and Nebraska. States that the Platte River contributes 10 percent of the sediment transported in suspension by the Missouri past Kansas City, that bank erosion is of minor importance, and that bed sediment transported to the Missouri River from the Platte affects adversely the regimen of the Missouri. Presents data on bank erosion and bed scour in the Platte River. Gives results of field investigations to deter-
- mine the quantity of sediment transported in suspension by the stream and its important tributaries. Discusses types of measurements; periods of investigations; relation of suspended sediment transported by the Platte to that carried by the Missouri; relative depths of erosion in the Platte and Missouri basins; suspended sediment discharge of the Elkhorn, Loup, and North Platte Rivers; mechanical composition of suspended sediment; character and amount of bed sediment of the Platte and its tributaries; volume-weight relationship of deposited silt; rates of silting of the existing Guernsey and Pathfinder reservoirs and of the proposed Ashland and other reservoirs in the Platte River basin; and the sedimentary characteristics of the various reservoir drainage basins.
68. Potomac River and tributaries including Occoquan Creek. 73d Cong., 1st sess., H. Doc. 101, 495 pp., illus., 1934.
Deals with existing conditions of and improvements to navigation, irrigation, flood control, water-power developments, and water supply of the Potomac River and its tributaries. Includes a brief discussion on the reservoir-silting problem. The average turbidity of the stream at Great Falls is about 140 p. p. m.; elimination of excessive peaks would reduce the average turbidity to 40 p. p. m. With the latter turbidity, 200,000 cu. yd. of mud would be deposited annually at the head of tidewater; the flood of 1924 deposited a total of 378,000 cu. yd. Proposed power-development reservoirs on tributaries would receive proportionate amounts of deposit, making the silt problem unimportant. The Great Falls reservoir, likely to receive the heaviest deposit, would not completely silt up for 645 yr.
69. Rappahannock River, Va. 73d Cong., 2d sess., H. Doc. 186, 97 pp., illus., 1934.
Deals with existing conditions of and proposed improvements to navigation, irrigation, flood control, and water-power developments of the Rappahannock River, Va. Includes one paragraph noting that between Fredericksburg and Port Royal freshets annually deposit 40,000 cu. yd. of silt in the Rappahannock. The silting of reservoirs is negligible.
70. Sacramento, San Joaquin, and Kern Rivers, Calif. 73d Cong., 2d sess., H. Doc. 191, 107 pp., illus., 1934.
Deals with existing conditions of and proposed improvements to navigation, irrigation, flood control, and water-power development on the Sacramento, San Joaquin, and Kern Rivers in California. Includes estimates of mean annual volume of silt passing various proposed reservoir sites, based on results of observations of silt passing Bullards Bar Dam (1927 and 1928) and of the silt content of Calaveras (1921 and 1922) and Tuolumne (1918) Rivers; estimates of debris reaching the McCloud River from mud flows of Mud Creek (1920, 1924-26) are given. Discusses the effects of barriers upon conditions of sedimentation at the mouths of the Sacramento and San Joaquin Rivers, and dredging costs.
71. Skagit River, Wash. 73d Cong., 2d sess., H. Doc. 187, 110 pp., illus., 1934.
Deals with existing conditions of and proposed improvements to navigation, flood control, and water-power developments on the Skagit River, Wash. Includes a brief discussion on the economic aspects of damage caused by the Skagit River flood of February 1932. Notes that the rich silt deposit above Burlington was of probably greater value than losses sustained during the flood. Describes in general conditions of bank erosion along the Skagit River, citing an example of excessive bank cutting. Notes that existing bank-protection works are only partially effective and makes recommendations. Discusses proposed power-development projects in the Skagit River basin and considers the problem of silting in the proposed reservoir on the Sauk River, estimating that the reservoir would be entirely filled with silt in 40-120 yr.

Notes a method of eliminating the major portion of this silt deposit by diverting the Suittale River.

72. Wabash River, Ohio, Indiana and Illinois. 73d Cong., 1st sess., H. Doc. 100, 172 pp., illus., 1934. Deals with existing conditions of and proposed improvements to navigation, irrigation, flood control, and water-power developments on the Wabash River in Indiana and Illinois. Banks of the Wabash and White Rivers are unstable, caving is common, and channels are shifting. Elimination of floods by channel improvement is considered practically impossible; cut-offs would be ineffective during large floods and any benefit would be local and not worth the improvement costs. Observations (1930) on silting above the Williams and Grand Rapids dams indicate that no appreciable silting had occurred above either dam during a period of about 20 yr. Results of investigations (1931) show that the Wabash carried a total silt load of 250 p. p. m. when low river stages prevailed. Considers the silt problem of the Wabash as relatively unimportant in planning reservoirs and other improvement works.
73. White and Bad Rivers, S. Dak. and Nebr. 73d Cong., 2d sess., H. Doc. 189, 53 pp., illus., 1934. Deals with existing conditions of and proposed improvements to navigation, irrigation, flood control, and water-power developments of the White and Bad Rivers in South Dakota and Nebraska. Discusses the extent of bank erosion and bed scour in streams, and investigations to determine the nature and quantity of sediment transported in suspension by the White River, Aug. 17, 1929-July 31, 1931. Compares the amount of sediment transported in suspension by the White River past Oacoma and the Missouri past Kansas City and relative quantities of solid material transported away from the respective drainage areas. Reports investigations to determine the nature and quantity of sediment transported in suspension by Bad River, Feb. 23-July 31, 1931, comparing the amount of sediment transported by the Bad River past Fort Pierre and by the Missouri past Kansas City, and the relative quantities of solid material transported away from the respective drainage areas. Describes the character of suspended and bed sediment of White and Bad Rivers (mechanical analysis) and bed-load movement. Includes computations to determine the anticipated rate of silting in potential reservoirs, and volume-weight determinations of deposit silt. The existing Little White River Reservoir silted 700 acre-feet in 7 yr. of operation. Estimates the rate of silting in the proposed Reliance Reservoir on the White River and the Teton Reservoir on the Bad River. Conclusions are drawn from silt investigations on the White and Bad Rivers.
74. Yellowstone River, Wyo., Mont., and N. Dak. 73d Cong., 2d sess., H. Doc. 256, 176 pp., illus., 1934. Deals with existing conditions of and proposed improvements to navigation, irrigation, flood control, and water-power developments on the Yellowstone River in Wyoming, Montana, and North Dakota, including extent of bank erosion and bed scour in the stream. Investigations to determine the quantity of silt transported by the Yellowstone River were conducted in Montana at Fairview (May 16-Nov. 16, 1931), at Glendive (Sept. 19, 1929-Nov. 30, 1930), and at Billings (Sept. 14-17, 1931), and by the Big Horn River at Hardin (Sept. 20, 1929-Nov. 30, 1930). Gives types of measurements. Compares silt carried by the Yellowstone past Fairview and Glendive, by the Missouri past Kansas City, by the Big Horn past Hardin, and by the Yellowstone past Glendive, and gives relative quantities of material transported away from the respective drainage areas. Investigates the character of suspended and bed silt of the Yellowstone and Big Horn Rivers. Estimates rate of silting in potential reservoirs in the Yellowstone River basin, based on volume-weight determinations of deposited silt, rates of silting in existing Intake and Boysen Reservoirs, and estimated life of potential reservoirs after construction. Conclusions drawn from silt investigations on the Yellowstone and Big Horn Rivers are given.
75. Alabama-Coosa branch of Mobile River system. 74th Cong., 1st sess., H. Doc. 66, 251 pp., illus., 1935. Deals with the present conditions of and proposed improvements to navigation, power development, and flood control on the Alabama-Coosa branch of the Mobile River system. Includes a brief discussion of the silting of reservoirs and notes that the problem is of little importance. Conditions of the erosion and sloughing of banks are noted. Silt determinations during the flood of 1909 gave a silt content of 0.015 percent; reservoir silting investigations (1910) show no evidence of the movement of heavy material but light loam and clay carried in suspension were deposited.
76. Big Sandy River, West Virginia, Kentucky, Virginia. 74th Cong., 1st sess., H. Doc. 245, 70 pp., illus., 1935. Deals with existing conditions of and proposed improvements to the Big Sandy River in West Virginia, Kentucky, and Virginia. Includes a brief discussion of the extent of bank erosion and the conditions of sand transportation and deposition in the stream.
77. Fabius River, Iowa and Mo. 74th Cong., 1st sess., H. Doc. 272, 33 pp., illus., 1935. Deals with existing conditions of and proposed improvements to flood control and water power developments on the Fabius River in Iowa and Missouri. Includes a brief discussion on conditions of erosion and deposition in the lower part of the Steffenville Drainage District and in the area on the North Fabius River at the lower end of the channel straightening works, stating that straightening to the stream's mouth will apparently control bed and bank erosion and prevent flood damage.
78. Kanawha River, W. Va., Va., and N. C. 74th Cong., 1st sess., H. Doc. 91, 123 pp., illus., 1935. Deals with proposed improvements to navigation, irrigation, flood control, and water-power development on the Kanawha River in West Virginia, Virginia, and North Carolina. Includes brief discussions on bank erosion, silt, and dredging for navigation improvements on the Kanawha River. Notes that bank erosion is a minor problem in the basin and silt carried during freshets in the lower Kanawha is deposited near the mouth of the stream, affecting the maintenance of the navigation channel. States that the bed and banks of New River are stable. Estimates rate of silting of the proposed Blue-stone Reservoir at 927 acre-feet per yr. based on the rate of silting of the Byllesby which had its capacity reduced from 7,800 acre-feet to 2,600 acre-feet after 20 yr. of operation.
79. Kansas River, Colorado, Nebraska, and Kansas. 73d Cong., 2d sess., H. Doc. 195, 331 pp., illus., 1935. Deals with existing conditions of and proposed improvements to navigation, irrigation, flood control, and water-power developments in the Kansas River basin in Colorado, Nebraska, and Kansas. Reports the extent of bank erosion and bed scour; the investigation of the nature and quantity of sediment transported by the Kansas River and its tributaries (June 1929-March 1931); the types of measurements; the computations of suspended sediment discharges at Turner and Bonner Springs, Kans., for the period Oct. 10, 1930-Mar. 21, 1931; the relation of material transported in suspension by the Kansas River to that by the Missouri River and the relative amount of erosion in their respective drainage areas; a comparison of sediment records (1929-31) with those of the U. S. Geological Survey (1906-08) for suspended sediment discharges and sediment concentrations of the Big Blue, Republican, Smoky Hill, Solomon, and Saline Rivers and their relation to suspended sediment discharge and sediment

concentration of the Kansas River; the character of bed and suspended sediment of the Kansas River (mechanical analysis); the relative capacities of the Missouri and Kansas Rivers to transport material; computations to determine the anticipated rate of silting in various potential reservoirs in the Kansas River basin; volume-weight determinations of deposited silt; rate of silting of the existing reservoir at Lawrence; and conclusions relative to erosion and sediment transportation in the Kansas River.

80. Missouri River. 73d Cong., 2d sess., H. Doc. 238, pp. 1032-1183, illus., 1935.

Presents results of an investigation to obtain basic data relative to the magnitude and nature of the sedimentary characteristics of the Missouri River system. Includes a physical description of the river system. Discusses origin of silt and economic aspects of soil erosion in the river basin; areas of the Missouri River basin most seriously affected by erosion; measures to prevent soil erosion and farm land wastage; silt transportation; measurements used in field investigations to determine the quantity of material in suspension carried by the Missouri and its more important tributaries; silt discharge past various sections of the Missouri River; variation of the silt-discharge relation of the Missouri River from its source to its mouth; influence of tributaries on silt load of the Missouri River; retention of silt in suspension; variation in silt discharge of the stream; relation of silt discharge to water discharge and to velocity; mechanical composition of suspended and bed sediment; comparison of suspended and bed sediment; volume-weight determinations of deposited silt; bed-load transportation; theoretical basis for the measurement of the amount of bed material transported in a stream by traction; results of bed-load-discharge determinations for the Missouri River and its tributaries; influence of bed-load contributions of tributaries upon the regimen of the Missouri River; relation between bed load and suspended load; variations in the conformation of stream bed; factors causing variations in stream-bed elevations; theoretical analysis of changes in a river bed; changes in elevation of the Missouri River bed; problems associated with the influence of sedimentary load; localized maladjustments in the river; canalization; off-channel harbors and industrial canals; rates of silting of proposed reservoirs in the Missouri River basin; the prevention or minimizing of silting in impounding reservoirs; and suitability of river sediment for the construction of levees and earth dams.

81. Roanoke River, Va. and N. C. 74th Cong., 1st sess., H. Doc. 65, 202 pp., illus., 1935.

Deals with existing conditions of and proposed improvements to navigation, irrigation, flood control, and water-power developments on the Roanoke River in Virginia and North Carolina. Includes a discussion on sedimentation in the Roanoke River basin. Methods of silt-load determinations involved turbidity measurements at the Weldon, N. C., and Danville, Va., filtration plants on the Roanoke and Dan Rivers respectively, and measurements of silt deposition in the Schoolfield and Walnut Cove Reservoirs on the Dan River. The suspended silt load at Weldon is estimated from data collected January 1927-December 1932 at 33 acre-feet of wet silt per year per 100 sq. miles of drainage area and at Danville, from data computed for the period 1923-31, at 32 acre-feet of wet silt per year per 100 sq. miles. The rate of silt deposition in the 11-yr. period 1904-15, in Schoolfield Reservoir, was 15.4 acre-feet per year per 100 sq. miles of drainage area, and in Walnut Cove Reservoir, for the 9-yr. period 1924-32, the annual rate of siltation was 23 acre-feet per 100 sq. miles. Data are presented on the estimated life of 12 proposed reservoirs in the Roanoke River basin. Includes a table showing silt content of various rivers and

reservoirs in the United States. States that siltation in the navigable channel below Weldon is not sufficiently serious to interfere with navigation.

82. Savannah River, Ga., S. C., and N. C. 74th Cong., 1st sess., H. Doc. 64, 150 pp., illus., 1935.

Deals with existing conditions of and proposed improvements to navigation, irrigation, water-power developments, and flood control on the Savannah River in Georgia, South Carolina, and North Carolina. Includes brief reference to means employed for river-bank protection to reduce shoaling in the navigable channel at Augusta. Estimates rates of silting for proposed reservoirs in the Savannah River basin based on estimated data for rates of reservoir silting in the Yadkin-Pee Dee basins.

83. Arkansas River and tributaries. 74th Cong., 1st sess., H. Doc. 308, vol. 1, 620 pp., illus., 1936. Deals with existing conditions of, and proposed improvements to navigation, irrigation, flood control, and water-power developments of the Arkansas River and its tributaries. Includes, in Appendix No. 9, a discussion of conditions of erosion and siltage in the Arkansas River basin. Considers the causes of erosion, siltage in streams of the arid Southwest, early silt observations in the Arkansas River system, silt observations of 1930-31, effect of erosion and siltage on the Arkansas River channel, bed load, means of preventing erosion, probable siltage from streams in the Arkansas River system, and probable life of reservoirs in the Arkansas River basin.

84. Minnesota River, Minn. 74th Cong., 1st sess., H. Doc. 230, 47 pp., illus., 1936.

Deals with existing conditions of and proposed improvements to navigation, irrigation, flood control, and water-power developments on the Minnesota River, Minn. Includes a brief discussion on the silting of proposed reservoirs. Notes that observations (June 1932-May 1933) indicate that the suspended-sediment load of the stream at Shakopee amounts to an estimated average of 2,000,000 cu. yd. annually; at this rate, the proposed Mendota Reservoir would fill in about 250 yr. Estimates the life spans of Lac qui Parle, New Ulm Reservoir, and Big Stone Lake at 700, 180, and 1000 yr., respectively. Considers briefly the effect upon navigation of snags created from bank cutting.

85. Ohio River. 74th Cong., 1st sess., H. Doc. 306, 194 pp., illus., 1936.

Deals with existing conditions of and proposed improvements to navigation, irrigation, flood control, and water-power developments on the Ohio River. Considers the possible reduction in maintenance costs resulting from proposed improvements for the purpose of eliminating dredging requirements. Lists data by pools and bars on the amount of dredging required to obtain a navigable channel of 500 ft. width, amounts of dredging after proposed improvements, and the maintenance dredging reduction by bank revetment and contraction works resulting in improved open-channel conditions. Notes conditions of silting at Lock and Dam No. 48 and the proposed remedy. Considers the problems of bear-trap design to flush deposits of sediment and other material. Examines the problem of silting of the proposed reservoirs, and briefly presents data on silting conditions in existing Lake Lynn, Quemahoning, Byllesby, O'Shaughnessy, Julian Griggs, Dix River, Great Falls, Wilson, and Hales Bar Reservoirs, Ocoee No. 1 and Cheoah plants, and reservoirs of the Miami Conservancy District. Discusses the effect of silting upon the life of anticipated flood-control structures in the Ohio Basin, silt contributions of the Ohio to the Mississippi River, and the extent of bank erosion along the Ohio River.

86. Red River, Arkansas, Oklahoma and Texas. 74th Cong., 2nd sess., H. Doc. 378, 833 pp., illus., 1936.

- Deals with existing conditions of and proposed improvements to navigation, flood control, irrigation, and water-power developments on the Red River in Arkansas, Oklahoma, and Texas. Describes past and present navigation projects to equalize the Red River flow, including clearing and snagging, dredging, levees, closing outlets, and bank protection. Present channel conditions are described, including conditions of erosion and the transportation and deposition of sediment. Various methods are considered for the improvement of the Red River for navigation such as uncontrolled flow by dredging, contraction works, and canalization and improvement with controlled flow by maintained low-water flow. States that caving banks and the shifting bed of the Red River make stabilization necessary before canalization. The sediment load of the stream is heavy at all stages; sand in the Red River is very fine, easily transported and readily deposited; pools of fixed dams would probably silt to crests within five years and pools of movable dams would be silted during freshets; a canalized system would not provide continuous navigation. In connection with proposed irrigation projects of the Red River basin, discussion on the rate of silting of the proposed reservoir is included.
87. Report on Little River, Oklahoma. 74th Cong., 1st sess., H. Doc. 308, vol. 2, pt. 6, pp. 937-987, illus., 1936.
Deals with existing conditions of and proposed improvements to flood control, water-power development, navigation, and irrigation on the Little River, Okla. Notes briefly studies indicating that erosion, which is the source of considerable sand and silt in Little River and Salt Creek, is best combatted by terracing operations on the watershed.
88. Report on South Canadian River, New Mexico, Texas and Oklahoma. 74th Cong., 1st sess., H. Doc. 308, vol. 2, pt. 5, pp. 811-936, illus., 1936.
Deals with existing conditions of and proposed improvements to irrigation, navigation, flood control, and water-power developments in the South Canadian River basin in New Mexico, Texas, and Oklahoma. Includes brief discussions on conditions of soil erosion, the accumulation of silt in river channels, and the effect of sand transported by the South Canadian River upon navigation on the Arkansas River. Estimates that the silt load of the South Canadian River will average about 2 1/2 percent by volume and the rate of silting of Dripping Springs Reservoir will be approximately 7,500 acre-feet per year.
89. Connecticut River, Mass., N. H., Vt., and Conn. 75th Cong., 2nd sess., H. Doc. 455, 112 pp., illus., 1938.
Deals with flood control on the Connecticut River in Massachusetts, New Hampshire, Vermont, and Connecticut. Includes brief discussion on the practicability of dikes for the protection of valuable commercial, industrial, and rural property on the banks of the Connecticut River, against erosion and other flood damages. A comprehensive system of dikes would increase stream velocities and cause bank erosion. The flood of 1927 deposited a gravel bar in Wells River, which diverted the current toward the Vermont shore, causing subsequent destructive bank erosion.
90. Hydraulic mining and debris control, Sacramento River and tributaries, California. 12 pp., illus. Sacramento, Calif., 1938.
Discusses briefly the historical development of hydraulic mining methods, the debris problem and its effect on extreme floods, action taken against hydraulic mining, the California Debris Act creating the California Debris Commission, and efforts of the Commission to control deposits on the Yuba River where the most threatening volume of debris had accumulated. Describes Bullards Bar Reservoir on the North Yuba River and Combe Dam on Bear River, noting provisions for debris storage, as well as the proposed Upper Narrows, North Fork, and Ruck-A-Chucky Reservoirs to be constructed by the California Debris Commission to retain mining debris, supplement low-water flows for irrigation purposes and develop power.
91. Basis of design for definite project report, Wolf Creek Dam and Reservoir, Cumberland River, Kentucky and Tennessee. 114 pp., illus. Nashville, Tenn., Nov. 1940.
Presents detailed data on the engineering features of the proposed Wolf Creek Dam and Reservoir on the Cumberland River in Kentucky and Tennessee, and on the hydrology of the Cumberland River basin above the proposed dam. Includes brief discussions on silt in the Cumberland River; results of silt measurements at Nashville, Tenn., for the periods Oct. 24, 1906-Nov. 3, 1907 and Jan. 1, 1934-Dec. 31, 1939; sedimentation data on reservoirs in the general vicinity of the upper Cumberland Basin; and estimated annual deposition in proposed Wolf Creek Reservoir.
92. Report on improvements of the passes of the Mississippi River. various paging. New Orleans, 1941.
Notes that the problem of shoaling in the navigation channels in the passes is affected more by the coarser materials moving along the river bed than by the fine material in suspension. Points out that soft mud material deposited in the zone of saltation during the low water season is believed to have been deposited by flocculation. Makes various recommendations.
93. Boyer River, Iowa. 78th Cong., 1st sess., H. Doc. 254, 33 pp., illus., 1943.
A report on a survey of the Boyer River, Iowa. Discusses the flood damages and the problem of flood protection. Treats bank erosion and silt, noting that at Logan, Iowa, from Apr. 1, 1939, to Mar. 31, 1940, the silt load was computed to be 3,000 acre-feet.
94. Muskingum River and its tributaries, Ohio. 78th Cong., 1st sess., H. Doc. 251, 99 pp., illus., 1943.
Deals with the Muskingum River and its tributaries in Ohio. Treats of flood control, navigation, development of water power, etc. Contains a paragraph on soil erosion and siltage, estimating a loss of 5 tons of soil per acre per year on the Muskingum watershed. Notes measurements indicating that the Licking River at Dillon Falls, after a 2.85-in. rainfall, carried 1,945 tons of soil material in 24 hr.
95. Mississippi River between Cairo, Ill., and Baton Rouge, La. 78th Cong., 2d sess., H. Doc. 509, 20 pp., 1944.
Includes review by the U. S. Mississippi River Commission of the navigation provisions on the project for the improvement of the Mississippi River adopted by the Act of May 15, 1928, as amended, with the idea of determining the advisability of increasing the depth of the navigable channel from 9 to 12 ft. between Cairo, Ill., and Baton Rouge, La. Treats bank caving and the river meander. Includes a map showing the Mississippi River meander belt reproduced from color drawings prepared by H. N. Fisk.
96. Report on sedimentation survey of Cottage Grove Reservoir. 15 pp., illus. Portland, Oreg., Engineer District, 1949.
Describes a sedimentation survey of Cottage Grove Reservoir near Cottage Grove, Oreg. on the Coast Fork of the Willamette River. From Oct. 28, 1942 to Dec. 1947, 127 acre-feet of sediment had been deposited in the reservoir. The volume of sediment is a loss of 0.4 percent of the original gross storage below normal pool elevation of 33,000 acre-feet. This represents an average annual sedimentation rate of 0.25 acre-foot per mile of area tributary to the dam. Results show the siltation will be a minor factor. At the present rate, a period in excess of 100 yrs. will be required to fill a volume equivalent to the dead storage space of the reservoir.
97. Report on sedimentation survey of Fern Ridge Reservoir. 16 pp., illus. Portland, Oreg., Engineer District, 1949.

Describes a sedimentation survey of Fern Ridge Reservoir on the Long Tom River, Lane County, Oreg. The purpose of the survey was to obtain data on the silting rate in order to make estimates of silt deposition in proposed reservoirs in the Willamette River basin. Considers distribution of sediment, character of sediment, and relation of sediment to runoff. Results indicate that not more than 500 acre-feet (one-half of one percent of reservoir capacity) has been lost because of sedimentation during the 6 yr. of use. This is an average annual sedimentation rate of 0.33 acre-foot per sq. mile of area which is tributary to the dam.

U. S. ENGINEER DEPT. VICKSBURG ENGINEER DISTRICT.

1. Sediment observations, 6 pp., illus. Vicksburg, Miss., U. S. Corps Engin., 1939.

A report which gives a general outline of various methods and equipment used in suspended and bed-load sampling in the Vicksburg Engineer District.

U. S. ENGINEER OFFICE, LOS ANGELES, CALIFORNIA.

1. Report on engineering aspects, flood of March 1938, 118 pp., illus., tables and graphs. Los Angeles, Calif., 1938.

Furnishes data of value in the analysis of design of the Los Angeles County Flood Control Project. Comments on bank erosion, debris deposits, and scour and fill. Discusses types of channel protection, determination of roughness factors, bends, debris basins, hydrology, transportation and deposition of debris in channels, etc. Data on siltation in reservoirs are also included.

U. S. FEDERAL INTER-AGENCY RIVER BASIN COMMITTEE. SUBCOMMITTEE ON SEDIMENTATION. See also Federal Inter-Agency Sedimentation Conference, 1; U. S. Interdepartmental Committee.

1. A study of methods used in measurement and analysis of sediment loads in streams - operation and maintenance of US P-46 suspended sediment sampler (preliminary). 39 pp., illus. Minneapolis, St. Anthony Falls Hydraul. Lab., 1949.

Consists of a manual of instructions which are applicable to suspended sediment samplers US P-46 No. 9-31, inclusive. The purpose of the report is to make the operation of these samplers easier for the beginner to understand. Mentions briefly the theory and basic concepts underlying the technique of sampling. Describes and gives the design of the US P-46 sampler. Comments on maintenance of the sampler. Deals with procedure for taking a sample.

2. Inventory of published and unpublished sediment-load data in the United States. U. S. Fed. Inter-Agency River Basin Com., Subcom. on Sedimentation, Sedimentation Bul. 1, 82 pp., tables, Apr. 1949.

A compilation of data for all existing sediment-load records through the water year ending Sept. 30, 1946. Gives such data as location, drainage area, period of record, number of observations, unit of expression, sampling equipment, and references to basic data.

U. S. FEDERAL POWER COMMISSION. See U. S. Federal Inter-Agency River Basin Committee.

U. S. FOREST SERVICE. See also U. S. Federal Inter-Agency River Basin Committee.

1. Handbook of erosion control engineering on the national forests. 90 pp. Washington, 1936.

A comprehensive report on methods of erosion control designed for use on national forests. Discusses the erosion problem on national forests, erosion-control measures, hydraulics of erosion control, gully structures, estimated cost of restoring gullies, soil-saving and debris dams, and miscellaneous structures. Describes methods of controlling mud and debris flows and channel erosion.

2. Influences of vegetation and watershed treatments on runoff, silting, and stream flow. U. S. Dept. Agr., Misc. Pub. 397, 80 pp., illus., July 1940.

A summary progress report of research dealing with land-water relationships, particularly the basic relationships between land use and runoff, debris deposition, the shoaling of stream channels, silting of reservoirs, storm

flows, and other phenomena that have followed logging, cultivating, burning, and grazing. Includes a discussion on the reservoir silting problem giving data relative to the economic aspects of the problem, rate of silting of representative reservoirs in the United States, reservoir silting conditions in the southern Piedmont region, Texas and the Great Plains region, silt removal from reservoirs, etc. The shoaling of channels and drainage canals is considered, discussing conditions in the middle Rio Grande Valley, and in streams of the Yazoo, middle and lower Mississippi, Potomac, and middle and lower Missouri River basins. Data are presented on damages to flood-plain soils in the headwater section of the Yazoo Basin, in Tobittubby and Hurricane Valleys, southeastern Piedmont, the Driftless Area of the Mississippi Valley, Winona County, Minn., Texas Coastal Plain, and the Ohio River Valley. Present research dealing with the effects of vegetation and land-use practices on runoff retardation and soil-erosion prevention is outlined.

U. S. GEOLOGICAL SURVEY. See also U. S. Federal Inter-Agency River Basin Committee; U. S. Interdepartmental Committee.

1. Fourteenth annual report, 1892-'93, pt I. 321 pp. Washington, 1893.

A report on work accomplished by the U. S. Geological Survey for the fiscal year ending June 1893. Contains a brief discussion on sedimentation, treating rate of settling of fine solid particles in liquids and factors affecting the rate of settling (pp. 162-163).

2. Operations of river stations, 1899. U. S. Geol. Survey, Water-Supply Paper 35, pt. 1, 99 pp., illus., 1900.

Contains descriptions of the river stations maintained during 1899, tables of daily water heights, and results of measurements of discharge. Describes briefly the method of Mr. Allen Hazen to determine the amount of suspended sediment which is dependent upon the degree of opacity of the water.

3. Operations at river stations, 1900, pt. I. U. S. Geol. Survey, Water-Supply Paper 47, 99 pp., 1901.

Presents results of observations of discharge measurements taken at the various river stations of the U. S. Geological Survey. Includes a four-page discussion on methods employed for the measurement of suspended material in streams.

4. Quality of surface waters of the United States, 1944. U. S. Geol. Survey, Water-Supply Paper 1022, 311 pp., 1947.

Consists of tables which give data on the quality of surface water of various streams in the United States. The samples analyzed were collected from Oct. 1, 1943, to Sept. 30, 1944. Includes records of suspended-sediment loads and daily water temperatures for certain rivers. Size-analysis records are included as a guide in estimating volumes of deposited matter.

U. S. INDIAN SERVICE. See U. S. Interdepartmental Committee.

U. S. INTERDEPARTMENTAL COMMITTEE (Tennessee Valley Authority, Corps of Engineers, Dept. of Agriculture, Geological Survey, Bureau of Reclamation, Indian Service, and Iowa Institute of Hydraulic Research).

A study of methods used in measurement and analysis of sediment loads in streams. Reports:

1. Field practice and equipment used in sampling suspended sediment. 175 pp., illus. Iowa City, St. Paul U. S. Engin. Dist. Sub-Off., Hydraulic Lab., Univ. Iowa, 1940.

Reviews field procedure and equipment used in the past in sampling suspended sediment loads of streams. Gives methods used in locating sampling points across a stream and selecting the depths of observations in a vertical. Presents the advantages and disadvantages of the various methods. The frequency with which samples should be taken is considered. Describes samplers used and illustrates 65 forms. Classifies samples as to mode of action

U. S. INTERDEPARTMENTAL COMMITTEE. - Continued and gives advantages and disadvantages of each class. Sets forth the requirements of a sampler which would meet all field conditions satisfactorily.

2. Equipment used for sampling bed load and bed material. 57 pp., illus. Iowa City, St. Paul U. S. Engin. Dist. Sub-Off., Hydraulic Lab., Univ. Iowa, 1940.

Reviews and classifies bed load and bed material samplers according to their type of construction and principle of operation. Describes and illustrates the samplers by photographs and drawings. Presents the results of calibration of bed-load samplers performed by Shamov, Einstein, Ehrenberger, and the Swiss Federal Authority for Water Utilization. Discusses various field conditions encountered in bed-load sampling and indicates type of sampler suitable for each case.

3. Analytical study of methods of sampling suspended sediment. 82 pp., tables and graphs. Iowa City, St. Paul U. S. Engin. Dist. Sub-Off., Hydraulic Lab., Univ. Iowa, 1941.

Presents an analysis of some of the sampling methods used in determining the magnitude of suspended-sediment loads of streams. Determines inherent errors of various sampling methods when used in a stream where the sediment concentration and velocity vary between the surface and the bed of the stream. Bases the analysis upon the assumption that the samples collected represent the true average value of the sediment concentration at every point of observation and that the sediment distribution conforms to the turbulence theory. Presents a method whereby the mean sediment concentration at a vertical in a stream can be determined from the concentration and size composition observed at any given point in a vertical.

4. Methods of analyzing sediment samples. 203 pp., illus. Iowa City, St. Paul U. S. Engin. Dist. Sub-Off., Hydraulic Lab., Univ. Iowa, 1941.

Discusses methods of determining particle size, particularly with reference to their adaptation to suspended sediment samples. Stokes' law is commented upon and graphical methods for calculating particle diameters from the observed fall velocities and fluid properties are presented for conditions where Stokes' law does and does not apply. Reveals that the greater number of the present methods are not sensitive or accurate enough for analyzing suspended samples of very low concentrations. Shows the need for the development of rapid, accurate, and reliable methods adaptable to mass analysis of suspended-load samples. Emphasizes the development of settling rate methods because the diameter calculated from a fall velocity is generally more valuable than sieve diameter or direct physical measurement. Describes methods of analyzing samples for total solids concentration and presents several relatively new methods.

5. Laboratory investigations of suspended sediment samplers. 99 pp., illus., tables and graphs. Iowa City, St. Paul U. S. Engin. Dist. Sub-Off., Hydraulic Lab., Univ. Iowa, 1941.

Presents the results of experimental studies of suspended sediment samplers. Sampler intake tubes and typical suspended sediment sampler intakes were tested to evaluate errors in the sediment concentration of samples due to poor sampler entrance conditions, deposition of sediment with flow through a horizontal cylinder, and loss of sediment in transferring samples to other containers. Tests were made with five representative slow-filling samplers to determine their filling characteristics under various conditions of stream velocity, sampling depth, and sampler operation.

6. Not published.

7. A study of new methods for size analysis of suspended sediment samples. 102 pp., illus., tables and graphs. Iowa City, St. Paul U. S. Engin. Dist. Sub-Off., Hydraulic Lab., Univ. Iowa, 1943.

Attempts to improve methods for analyzing suspended sediment samples for all sizes and

concentrations which are encountered in flowing streams. Describes the bottom withdrawal tube developed during this study. Particle-size distribution can be computed with the aid of the so-called Odén curve. Reviews the range of conditions for which the present methods of size analysis are suitable. Describes various devices and the method of computing the size analysis of sediments on the basis of a uniform dispersion of particles. This method is modified for application to data obtained with the bottom withdrawal tube. Includes a description of tests made to determine the accuracy and range of applicability of the apparatus.

8. Measurement of the sediment discharge of streams. 92 pp., illus., tables and graphs. Iowa City, St. Paul Dist. Sub-Off., Corps of Engin. Hydraulic Lab., Univ. Iowa, 1948.

Clarifies the principles of sediment transportation and summarizes the practices most commonly used in carrying out fluvial sediment investigations. Deals with the necessity for studying sediment-load problems and presents a history of early sediment measurements. Describes types of sediment transportation and gives an explanation for the vertical distribution of suspended sediment, based on the turbulence concept. Treats of the general principles involved in suspended-sediment measurements and the practical aspects of selecting sampling points and determining the frequency of sampling. Describes the principal types of suspended-sediment samplers and gives details regarding sampler designs developed after a thorough study of existing sampler equipment. Methods and equipment used for bed-load sampling are given.

9. Density of sediments deposited in reservoirs, by E. W. Lane and Victor A. Koelzer. 60 pp., illus., tables and graphs. Iowa City, St. Paul U. S. Engin. Dist. Sub-Off., Hydraulic Lab., Univ. Iowa, 1943.

Reviews comprehensively information from published literature on the density of sediments deposited in reservoirs. Studies this literature and unpublished quantitative data with the idea of summarizing the data in a form applicable to engineering problems. The literature includes work in Elephant Butte Reservoir, Colorado River basin, Texas reservoirs, Missouri River, Miami Conservancy District retarding basins, European investigations, etc. Presents data on sediment densities and size composition which have not been published before. Results and conclusions are summarized in a form which is useful in reservoir design.

10. A study of methods used in measurement and analysis of sediment loads in streams; progress report, comparative field tests on suspended sediment samplers, by Paul C. Benedict and Martin E. Nelson. 58 pp. and appendixes, illus., tables and graphs. Iowa City, Hydraulic Lab., St. Paul Engin. Dist. Sub-Off., U. S. Engin. Dept., 1944.

Comments on experimental models of depth-integrating and point-integrating sediment samplers, designated U.S.D-43 and U.S. P-43, respectively, which were completed in 1943. This improved sediment-sampling equipment was subjected to tests under practical field conditions alongside of and in comparison with other sediment samplers in current use. This report analyzes the comparative test data submitted in reports by thirteen field offices. Reports of the field agencies are attached to the joint report in thirteen appendixes essentially in the form in which they were submitted. Discusses results, conclusions, and recommendations respecting further development of sampling equipment as indicated by the field reports.

U. S. MISSISSIPPI RIVER COMMISSION.

1. Preliminary report. U. S. Engin. Dept., Rpt. 1881, pt. 3, pp. 2719-2738, illus.

Points out the similarity between the Mississippi and other silt-bearing rivers flowing through alluvial deposits. No fixed relation has been discovered between the volume of water and its sediment load for any given observed velocity. Summarizes general principles

- governing the relationship between volume, velocity, and silt-transporting power of a stream. Discusses laws of river hydraulics to show the falsity of the belief that crevasses prevent the recurrence of destructive floods by supplying additional avenues for escape of flood waters.
2. Report. U. S. Engin. Dept., Rpt. 1882, pt. 3, pp. 2745-2783, illus.
Notes the effect of the large sediment discharge of the Missouri on the clarity of Mississippi River water. Discusses a plan to build new banks by causing deposition of suspended sediment through retardation of the current with wire or willow screens. States the controlling principles of river hydraulics affecting scour and deposition, and that the process is self-regulatory in a natural stream. Notes the influence of levees on river regimen.
 3. Report...upon observations at Carrollton, La., December 1879 to October 1880. U. S. Engin. Dept., Rpt. 1883, pt. 3, pp. 2209-2225, illus.
Presents results of discharge and sediment observations by the Mississippi River Commission at Carrollton, La., for the period December 1879-October 1880. Includes a discussion on the quantity and characteristics of the bed load transported by the river.
 4. Results of gauging operations on the upper Mississippi River, from December 1880 to October 1881. U. S. Engin., Dept., Rpt. 1883, pt. 3, pp. 2226-2265, illus.
Presents results of current and sediment observations at various stations on the Mississippi River for the period December 1880-October 1881.
 5. Report of B. M. Harrod on the protection of banks of the Mississippi River. U. S. Engin. Dept., Rpt. 1885, pt. 4, pp. 2880-2887.
Discusses results of sediment, velocity, and bank-caving observations in connection with the protection of banks of the Mississippi River as part of a plan for the improvement of the river below the mouth of the Missouri.
 6. Caving banks from Cairo to Donaldsonville. U. S. Engin. Dept., Rpt. 1892, pt. 4, pp. 3110-3117.
Presents results of a study of a bank-caving survey (1892) on the Mississippi River from Cairo to Donaldsonville, comparing them with results of previous surveys.
 7. Map of the Mississippi River from Cairo to Donaldsonville. 26 sheets, Apr. 5, 1892.
Shows areas of bank erosion as determined by a special survey made Nov. 20, 1891-Mar. 20, 1892. Attached is a bar graph showing the annual amount of caving per mile of river.
 8. Report of Mr. Kivas Tully, Assistant Engineer, on gauges, reduction of physical data, office records, and publications. U. S. Engin. Dept., Rpt. 1901, pp. 126-217, illus.
Presents detailed results of various hydraulic observations on the Mississippi River. Includes results of a scour and fill survey at New Madrid Bend (August 1899-October 1900).
 9. Special report...on revision of plans for improvement of navigation and flood control of the Mississippi River. 70th Cong., 1st sess., H. Com. on Flood Control Doc. 1, 309 pp., illus., 1928.
Presents a revised plan for flood control and improvement of navigation on the lower Mississippi River necessitated by the flood in the spring of 1927. Includes a brief discussion on the extent and character of bank caving and sediment transportation, and bar and navigable depth conditions in the stream. The transcript of testimony taken at public hearings on the effects of the flood occupies 239 pages of the report.
 10. The improvement of the lower Mississippi River for flood control and navigation. 3 vols., illus. St. Louis, Mo., M. R. C. Print, 1932.
Presents a detailed account of the history of improvements to the lower Mississippi River for flood control and navigation. Gives the history of discovery and investigation of the river. Describes the watershed, its geological history, the composition of material underlying the surface of the alluvial valley, the character of the bed and banks of the stream, bank erosion, bar formation and the effect of cut-offs; hydraulics of the lower Mississippi River; sediment investigations made on the stream, characteristics of the stream as they relate to the transportation of solid matter, the levee system on the lower river, dredging operations, types of bank protection and contraction works, navigation improvements, and floods and flood control. A bibliography is included.
 11. Model study of effects of operating Bird's Point-New Madrid Floodway. U. S. Waterways Expt. Sta., Paper C, 29 pp., illus., Dec. 1932.
Describes results of a study on a model of Bird's Point-New Madrid Floodway and the effects of its operation. Results of observations on conditions of erosion and deposition in the floodway are briefly described.
- U. S. MISSOURI RIVER COMMISSION.
1. Instruments and methods used in taking and reducing sediment and velocity observations on the Mississippi, Missouri, and Arkansas Rivers, 1879. U. S. Engin. Dept., Rpt. 1887, pt. 4, pp. 3121-3124, illus.
Describes apparatus and methods employed by the Missouri River Commission relative to sediment and velocity determinations on the Mississippi, Missouri, and Arkansas Rivers, 1879.
- U. S. MISSOURI RIVER COMMISSION. PHYSICAL DATA DEPT.
1. Report for the fiscal year ending June 30, 1887. U. S. Engin. Dept., Rpt. 1887, pt. 4, pp. 3079-3096.
Presents results of discharge and sediment observations on the Missouri River. Gives method of making sediment observations (1879) at Saint Charles, Mo.; tabulated results; comparison with coincident observations taken on the Mississippi at Columbus, Ky.; conclusions as to sources of sediment in both rivers; and conformity of results with theory of flow.
- U. S. NATIONAL BUREAU OF STANDARDS.
1. Report on scour of a sandy river bed by clear and muddy water. 37 pp. Washington, 1936.
Presents the results of laboratory tests which show that when water contains fine clay in suspension a greater velocity is needed to scour a given amount of sand than when the water is clear. Shows that a considerable increase in scour results from a small increase in velocity above the critical velocity required to start a general movement of the sand. Notes that if clear water discharges upon the bed of the Colorado sand below Boulder (Hoover) Dam it will tend to pick up more sand in suspension and in a rolling movement than when the water was previously muddy.
 2. Report on investigation of density current requested by the Geological Survey, U. S. Department of the Interior, on March 10, 1936. 21 pp., illus. Washington, 1938.
Discusses the problem and gives a definition of density currents. Describes experiments, noting apparatus used, procedure, etc. Comments on results of experiments. Treats the flow of density currents and gives conclusions.
- U. S. NATIONAL RESOURCES COMMITTEE, SPECIAL ADVISORY COMMITTEE ON STANDARDS AND SPECIFICATIONS FOR HYDROLOGICAL DATA.
1. Deficiencies in basic hydrological data. 66 pp., illus. Washington, 1936.
Cites examples of social and economic losses due to a lack of basic hydrological data and proposes remedies for current deficiencies essential to sound water conservation. Includes a description of current programs, outstanding deficiencies, and proposed remedies for the collection of hydrological data with reference to the quality of waters used for municipal supply, irrigation, recreation, and wildlife conservation purposes; and dissolved- and suspended-load and bacterial-content determinations. Lists a number of silt measurement stations operated by various agencies in the various States.

U. S. NATIONAL RESOURCES PLANNING BOARD.

1. Regional planning X. The Pecos River, joint investigation in the Pecos River basin in New Mexico and Texas. Summary, analyses, and finding. 207 pp., illus. Washington, 1942.

The investigation is concerned with the water problems of the Pecos River basin, in western Texas and eastern New Mexico. Tables give data on Aguja, Balmorhea, Storrie, Bonito, Alamogordo, McMillan, Avalon, and Red Bluff Reservoirs. Makes comments on surveys and on sedimentation damages in the Pecos River watershed.

U. S. NAVY DEPT.

1. Reports of the Secretary of the Navy, and the Commission by him appointed, on the proposed new Iron Navy Yard at League Island. 56 pp. Philadelphia, Collins Printer, 1863.

General information on League Island, which was reclaimed from marsh in 1843 and 1844 by an earth embankment and stone wall and used for farming purposes. Notes that large areas of marsh have formed around the island from immense deposits of the Delaware River.

U. S. OFFICE OF LAND USE COORDINATION.

1. The land in flood control. U. S. Dept. Agr., Misc. Pub. 331, 38 pp., illus., 1938.

Describes the role of land and vegetation in flood control, extent of vegetal depletion, limitations of vegetal controls, effect of erosion on structures, procedures under flood-control acts, watershed surveys, and nature of watershed measures. Gives a pictorial review of water control by land measures. Includes a page of general information on stream-channel aggradation in the Rio Grande Valley of central New Mexico, Anacostia River, D. C., Galena River, Ill., Pearl River, Miss., and Arkansas River, Kans. and two pages on economic aspects of silting and methods of prevention including a brief statement as to rate of silting in Spartanburg Reservoir, S. C., Lake Waco, Tex., Lake Olathe, Kans., Elephant Butte, N. Mex., Gibraltar Reservoir, and flood control reservoirs in California.

U. S. OFFICE OF LAND UTILIZATION. See U. S. Federal Inter-Agency River Basin Committee.

U. S. RECLAMATION SERVICE.

1. First annual report...June 17 to December 1, 1902. 317 pp., illus. Washington, 1903.

Deals with various aspects of irrigation works for the reclamation of arid lands including results of observations of the amount of water available together with the determination of the amount of suspended material in the Gila River at San Carlos Dam site (1901-02). Gives results of sediment observations of Salt River at the proposed reservoir site below Tonto Creek, Livingstone, Ariz. (1901-02), the amount of silt carried by the Colorado River at Yuma, Ariz. (1900-01), analyses of Colorado River water, and plans for combatting silt deposition in and for clearing silt from proposed reservoirs.

2. Fifth annual report...1906. 312 pp., illus. Washington, 1907.

Presents a detailed discussion on and description of various irrigation projects of the U. S. Reclamation Service. Includes brief data on Missouri River silt measurements (May-June 1906), amount of silt carried at various stages, and rate and amount of deposit at various velocities of flow.

U. S. SOIL CONSERVATION SERVICE.

1. Instructions for reservoir sedimentation surveys. U. S. Soil Conserv. Serv., SCS-SS-2, 36 pp., illus., Jan. 1, 1936.

A manual of instructions for making reservoir sedimentation surveys. Discusses purpose and general plan of surveys, and choice of reservoirs and methods. Three methods are outlined, namely contour method, range method, and a combination of range and contour. Under range method is discussed primary control, secondary control, range locations, elevations and profiles, direct measurement of silt, use of silt sampler or spud, measurement of volume of delta deposits, plotting and planimetry,

computation of original capacity and silt volume, and derivation of the formula used for computations. Under contour method is discussed primary control, surface mapping, subsurface contour mapping, and computation of original capacity and silt volume. Additional information is included on further computations, note keeping, survey monuments, preparation of final reports, preparation of maps, illustrations and supplemental material, and public relations.

2. Erosion losses from a 3-day California storm, by J. G. Bamesberger. 23 pp., illus. Washington, 1939.

Discusses characteristic conditions of Las Posas, La Habra, and Alison Creek demonstration projects, and two Civilian Conservation Corps work areas under the U. S. Soil Conservation Service that were drenched by the storm Feb. 28-Mar. 3, 1938. Notes the relation of soil loss to type of treatment of land, crops, soils, and slopes; measurements of gullies and deposition in the Las Posas project area; and observations of landslips in La Habra area. Presents data on soil losses due to gullying, new gully formations, effectiveness of the gully-control structure, and lands damaged by deposition. Notes that 4,287,000 cu. yd. of rich topsoil were washed onto productive land, into streams, and into the ocean.

3. From ridge to river. 14 pp., illus. Washington, 1939.

Describes the effects of erosion upon soil and cooperative efforts for soil defense by farmers of the upper Mississippi Valley. Contains three paragraphs which indicate that silt, a result of erosion, smothers crops and covers fertile bottom lands; is deposited in streams, lakes, and urban areas; and decreases the useful life of many reservoirs. Cites cases of reservoir silting at Lake Como, Hokah, Minn., which in 10 yr. was reduced to a worthless mud flat; at Lake Calhoun, Galva, Ill., which silted 52 percent of its original capacity in 13 yr.; and in reservoirs at West Frankfort and Galesburg, Ill., in which silting has destroyed 8 percent of the storage capacity in 14 yr.

4. Instructions for reservoir sedimentation surveys (appendix to Technical Bulletin 524, Silting of reservoirs, by Henry M. Eakin, 1936; revised by Carl B. Brown, 1939). U. S. Soil Conserv. Serv., Sedimentation Div., Tech. Let. Sed-8, 22 pp., Feb. 24, 1939.

Gives instructions for the making of sedimentation surveys. Deals with such subjects as purpose of survey, plan of survey, choice of reservoirs, choice of methods, contour method, range method, combination of ranges and contours, computation of original capacity and silt volume, triangulation control, surface contour mapping, and subsurface contour mapping.

5. Report on the field training conference for sedimentation specialists, Flood Control Surveys, U. S. Department of Agriculture, held at Oxford, Miss., and Denton, Tex., Feb. 27-Mar. 18, 1939. U. S. Soil Conserv. Serv., Sedimentation Div., Tech. Let., Sed-13, 40 pp., illus., Aug. 30, 1940.

Discusses a field conference for the study of methods of sedimentation investigations as related to flood-control surveys which was held under the supervision of the Sedimentation Division of the U. S. Soil Conservation Service, at Oxford, Miss., Feb. 27-Mar. 11, 1939 and at Denton, Tex., Mar. 13-18, 1939, the purpose of the conference being to promote development of uniform methods in the sedimentation phases of flood-control surveys and to familiarize representatives of Flood Control Survey parties with methods of investigation of sedimentation developed by the Sedimentation Division.

6. Instructions for numbering stream and valley field notebooks. U. S. Soil Conserv. Serv., Sedimentation Div., Tech. Let., Sed-12, 1 p., Mar. 27, 1940.

Gives a procedure to be used in the numbering of stream and valley field notebooks; shows letter symbols designated for work areas.

7. Reconnaissance investigations of reservoir silting

in connection with flood-control surveys. U. S. Soil Conserv. Serv., Sedimentation Div., Tech. Let., Sed-2a, 13 pp., July 1, 1941.

A general guide for personnel engaged in reconnaissance investigations of reservoir silting, especially in connection with flood-control surveys, preliminary examinations, and in soil conservation district planning. Discusses objectives of survey, plan of reconnaissance, sources of information, and methods of field examinations.

8. Hydrologic data; North Appalachian experimental watershed, Coshocton, Ohio. U. S. Dept. Agr., Hydrologic Bul. 1, 193 pp., illus., tables and graphs, Nov. 1941.

Presents basic hydrologic data collected at the North Appalachian Experimental watershed near Coshocton, Ohio. Data were collected primarily to determine the effect of agricultural land-use practices on the conservation of soil and water and on floods. These data are also needed in economically designing the erosion, flood-control, and hydraulic works used in a water and soil conservation program. Gives data on precipitation, runoff, humidity, land use, etc. Gives silt loss in runoff water as tons per acre. This silt loss was measured by silt boxes and Ramser silt samplers.

9. Hydrologic data; Blacklands experimental watershed, Waco, Texas, 1937-1939. U. S. Dept. Agr., Hydrologic Bul. 2, 197 pp., illus., tables and graphs, 1942.

Describes hydrologic studies of an area known locally as Bushy Creek watershed about 15 miles southeast of Waco, Tex., in the Brazos River basin. This area is typical of the Blacklands of Texas. Summaries of rainfall and runoff are given. Land-use distribution, soil moisture, evaporation, wind movement, humidity, etc., are included in the report. Soil transported by streams was measured by silt boxes and Ramser silt samplers. Data are presented primarily to determine the effect of agricultural land-use practices on the conservation of soil and water and on floods. These data are useful for designing the erosion, flood control, and hydraulic structures used in conservation programs.

10. List of publications and reports on sedimentation. U. S. Soil Conserv. Serv., Sedimentation Div., Tech. Let., Sed-15d, 17 pp., Jan. 1947; addenda, 3 pp., May 1, 1949.

A bibliography of publications and reports of work done by the U. S. Soil Conservation Service dealing with sedimentation. The 271 articles listed cover the period from Jan. 1, 1935 to May 1, 1949.

11. Instructions for the construction and installation of the Ramser silt sampler. U. S. Soil Conserv. Serv., SCS-TP-5, 8 pp.

Gives instructions for the construction and installation of the Ramser silt sampler. Includes various details and plans used in construction and installation.

U. S. SOIL CONSERVATION SERVICE. UPPER MISSISSIPPI REGION.

1. Topsoil; its preservation. 22 pp., illus. Washington, 1937.

Describes conservation practices for the preservation of topsoil, particularly in the upper Mississippi Valley. Illustrations showing Lake Como near Hokah, Minn., in 1926 and in 1936 are included. Notes that the lake is now (1936) silted full, a result of soil losses from steep cultivated and deforested slopes.

U. S. SOIL EROSION SERVICE.

1. Water and soil erosion. 73d Cong., 2d sess., H. Doc. 395, pp. 34-37, illus., 1934.

A technical report proposing a working plan for erosion prevention in the United States. Defines the soil erosion problem for the United States, and notes effects of accelerated erosion on silting in channels and reservoirs, and on valley land deposition.

U. S. TENNESSEE VALLEY AUTHORITY. See also U. S. Federal Inter-Agency River Basin Committee; U. S. Interdepartmental Committee.

1. Report to the Congress on the unified development of the Tennessee River system. 105 pp., illus., maps. Washington, 1936.

A report on the plan, policies, and constructional operations of the Tennessee Valley Authority. Describes benefits to be derived from control of the river and major and minor tributaries by means of reservoirs to control silting. Soil erosion and conservation in the Tennessee River Valley are considered. Notes the silting of Hales Bar.

2. Hydraulic data activities of the Tennessee Valley Authority. U. S. Tenn. Val. Authority, Water Control Planning Dept., Tech. Monog. 43, 43 pp., illus., Oct. 1939.

Describes recent hydraulic activities of the Tennessee Valley Authority. Gives an account of the silt investigations by the Hydraulic Data Division to determine silt volumes in Authority's reservoirs, to show rates of soil erosion in the Tennessee Valley, to estimate turbidity of present and future water supplies, and to estimate the necessary extent of dredging in channels below dams on the Tennessee River. Silt-sampling program to ascertain suspended-load determinations and results of investigation on rates of silting in Lake Wilson and Hales Bar Reservoir is given. Notes the effect of upstream reservoirs in reducing siltation rates. Results of studies on rates of silting in tributary reservoirs, namely Andrews Reservoir, Lake Davy Crockett, and Caryville Lake are given. States that these investigations serve as a basis for determining probable rates of silting in other tributary reservoirs, and supplement data on suspended-load determinations. Studies on the distribution of silt in cross-sections of Holston River at Jefferson City, and factors affecting the distribution are discussed. Notes analyses made to determine plant food elements in silt samples from Tennessee Basin streams and the Mississippi River. Turbidity and silt underflow investigation of Norris Reservoir are noted.

U. S. TENNESSEE VALLEY AUTHORITY. AGRICULTURAL RELATIONS DEPT., COMMERCE DEPT., AND HYDRAULIC DATA DIVISION.

1. Plant nutrient losses in the Tennessee River system. 48 pp., illus., tables and graphs. Knoxville, 1943.

Deals with losses of soil material and plant nutrients through erosion in the Tennessee Valley. Considers the composition of the major plant nutrients and gives the results of chemical analysis of silts in the Tennessee River system. Treats of the loss of nutrients in the silt carried from the soils of the valley and shows that the loss of silt in 1939 per acre of raw crop, idle, and other land in the watershed, varied from 3.5 tons at Knoxville to 14.5 tons at Johnsonville, less the Duck River. Determinations were also made of the content of bases in solution in water which was associated with silt samples.

U. S. WATERWAYS EXPERIMENT STATION. VICKSBURG, MISS.

See also Russell, R. D., 8.

1. Sediment investigations on the Mississippi River and its tributaries prior to 1930. U. S. Waterways Expt. Sta., Paper H, 84 pp., July 1930.

Discusses methods of transportation of sedimentary material. Outlines the history and description of investigations dating from 1838. Discusses the physics of sediment in suspension with regard to the relationship between material in suspension on river stage, classification of sediment in motion, causes of suspension, changes in saturation due to local causes, and size of particles carried in suspension. Extensive data on results of sediment observations are tabulated.

2. Experiments to determine the erosive effects of floodwaters on railroad embankments. U. S. Waterways Expt. Sta., Paper R, 11 pp., illus., May 1931.

Describes experiments to determine the erosive action and general destructive effects of floodwaters on low railroad embankments.

U. S. WATERWAYS EXPERIMENT STATION, VICKSBURG, MISS. - Continued

3. First floodflow experiments of Vicksburg Hydraulic Laboratory. Engin. News-Rec., vol. 108, no. 24, p. 970, illus., June 11, 1931.
Presents briefly results of model tests by the U. S. Waterways Experiment Station at Vicksburg, Miss., on overflow erosion of a railway embankment and backwater limits on the Illinois River.
4. Sediment investigations on the Mississippi River and its tributaries, 1930-1931. U. S. Waterways Expt. Sta., Paper U, 105 pp., illus., Dec. 1931.
Describes observations and presents tabulated results obtained on sediment investigations on the Mississippi River and its tributaries during 1930-31. Observations were made at 10 stations on the Mississippi and its upper tributaries and outlets to collect data on the quantity of sediment carried under varying conditions of stage and flow. Describes the Mississippi River Commission's sediment trap employed to secure samples at Carrollton, and the method of obtaining sediment samples; investigations to obtain data relative to the silting of proposed flood-control reservoirs at 16 points on tributary streams in the lower Mississippi Valley; Memphis and Vicksburg sediment traps; methods of laboratory analysis of samples and laboratory equipment; computations of sediment and water discharge; sediment distribution in stream cross-section; Mississippi River Commission and mean-depth methods of obtaining mean sediment content; and field and laboratory methods of volume-weight determinations of deposited silt. Results of investigations are tabulated.
5. Model study of effects of dikes on the river bed at Walker Bar, Ohio River. U. S. Waterways Expt. Sta., Paper L, 17 pp., illus., Jan. 1932.
Describes conditions and results of model experiments to determine an economical system of contraction works which would produce sufficient bed scour to secure a continuous channel across Walkers Bar and would prevent or decrease the caving of banks. Results of tests indicate that a system of dikes may be satisfactorily employed to gain the desired results.
6. Experiment to determine the effects of proposed dredged cut-offs in the Mississippi River. U. S. Waterways Expt. Sta., Paper I, 62 pp., illus., Apr. 15, 1932.
Describes model experiments to determine the hydraulic effects of dredged cut-offs in the Mississippi River. Results of erosion and sedimentation studies in connection with the experiments are briefly given.
7. Model studies of dike location. U. S. Waterways Expt. Sta., Paper 11, 78 pp., illus., June 1933.
Presents results of model studies to determine the effects of proposed channel improvements by means of dikes at four reaches in the Mississippi River and one in the Ohio River. In an appendix to the paper, a discussion of the theory and design of moveable bed models employed in the experiments is given.
8. Investigations of certain proposed methods of bank and embankment protection. U. S. Waterways Expt. Sta., Paper 12, 23 pp., illus., July 1933.
Describes and presents results of model studies relative to the effectiveness of various proposed methods for the protection of railroad embankments against overflow and of various proposed types of bank revetment.
9. Model study of shoaling below Starved Rock Lock and Dam, Illinois River. U. S. Waterways Expt. Sta., Paper 13, 19 pp., illus., Aug. 1933.
Deals with a model study to determine causes and conditions of shoaling below Starved Rock Lock and Dam, Illinois River. Describes the model and the general scheme of operation. Gives results of experiments dealing with the effects of closing the breach in the cofferdam and the effect of a solid cofferdam on the amount of shoaling; a suitable method of operation of Taintor gates; the effects of substituting a pier dike for the existing impermeable cofferdam; the effects of dikes between the islands; erosion and shoaling at Plum Island and Leopold Island No. 1; and the effects of relocation of bank lines.
10. Sediment investigation in the Atchafalaya Basin. U. S. Waterways Expt. Sta., Tech. Memo. 48-1, 27 pp., tables and graphs, 1934.
Presents results of investigations of samples of suspended and bed materials from the Atchafalaya River and some of its branches, May 25-July 28, 1933. Describes methods and equipment used.
11. Model structures for channel stabilization, Mississippi River. U. S. Waterways Expt. Sta., Paper 15, 57 pp., illus., Jan. 1934.
Presents in a condensed form the results of model studies as an aid in the solution of navigation problems at Port Chatres, Brooks Point, Hotchkiss Bend, and Point Pleasant on the Mississippi River.
12. Effect of turbidity on sand movement. U. S. Waterways Expt. Sta., Tech. Memo. 36-3, 27 pp., 1935.
A report which shows that the rate of sand movement tends to increase as the amount of turbidity increases and that no rational explanation can be given for large variations in the rate of sand movement and the formation of riffles.
13. Studies of river bed materials and their movement, with special reference to the lower Mississippi River. U. S. Waterways Expt. Sta., Paper 17, 161 pp., illus., Jan. 1935.
Describes apparatus and procedures employed in and results of flume studies of river-bed materials and their movement to determine the effects of variation in the composition of sediment, slopes of bed and water surface, and depth of water in the flume, also describes the scope, procedure, sampling method and apparatus, and results of the mechanical analysis of 531 samples of river-bed material taken from the Mississippi River between Cairo and New Orleans and 143 samples from tributaries to determine the composition of the material in the bed of the lower Mississippi River and its progressive variation throughout the course of the stream.
14. Analyses of sediment and sand samples, Calcasieu Pass, Louisiana. U. S. Waterways Expt. Sta., Tech. Memo. 119-1, 49 pp., illus., 1937.
A report which presents the results of analyses of 196 sediment and 35 bottom samples from Calcasieu Pass, La.
15. Report on sediment investigations, Mississippi low water of 1936. U. S. Waterways Expt. Sta., Hydraulic Res. Center, Tech. Memo. 120-1, 7 pp., tables and graphs, Apr. 28, 1937.
A record of analyses to determine why the water was clear at some localities during low stages of the Mississippi River in 1936. This was believed to be due to chemicals resulting in flocculation of suspended matter. The study gives results of sampling suspended material from the waters of the Mississippi and Atchafalaya Rivers during the low water period of 1936. Dissolved matter contained in the samples was determined. Results of the study are given.
16. Model study of the plans for channel improvement at Dogtooth Bend, Mississippi River. U. S. Waterways Expt. Sta., Hydraulic Res. Center, Tech. Memo. 109-1, folder no. 1, 48 pp., illus., Apr. 2, 1938.
A report of the experiments on a small-scale model of the reach of the Mississippi River near and including Dogtooth Bend near Cairo. The study was made to develop a suitable alignment for navigation, to minimize the attack on bank protection works, and to improve depths for navigation.
17. The Mayersville sediment survey. U. S. Waterways Expt. Sta. Bul., vol. 1, no. 1, p. 7, illus., June 1, 1938.
Describes the nature of sediment investigations at Mayersville Discharge Range, on the Mississippi River. Results of a typical observation showing grain size and sediment distribution in a vertical section at Mayersville, Miss., are presented.

18. Model study of the channel improvement and stabilization in the Pryors Island reach of the Ohio River. U. S. Waterways Expt. Sta., Hydraulic Res. Center, Tech. Memo. 107-1, folder no. 1, 63 pp., illus., Sept. 1, 1938.

A complete report on a model study of the Pryors Island reach of the Ohio River, made to determine the best plan of regulating works for stabilization and improvement of the channel. Twenty proposed improvement plans were tested in the model and results are given.
 19. Shoaling in Galveston Bay investigated by model. U. S. Waterways Expt. Sta. Bul., vol. 1, no. 2, pp. 12-13, illus., Oct. 1938.

Briefly describes a model study, now in progress, to determine the causes of shoaling in Galveston Bay and to develop means for minimizing this shoaling. The model is now being verified.
 20. Study of materials in suspension, Mississippi River. U. S. Waterways Expt. Sta., Hydraulic Res. Center, Tech. Memo. 122-1, 22 pp., illus., Feb. 1, 1939.

Presents basic data resulting from a study to determine the quantity and characteristics of suspended material transported by the Mississippi River at all stages, and to measure the corresponding hydraulic elements. Discusses the technique and procedure of field operations involved in the study, describing the location of the study, the method of sediment sampling, apparatus employed, velocity and sounding measurements, temperature determinations, and gauge readings. Describes the procedure for laboratory analysis of samples to determine the solids content, ratio of coarse and fine sediment, and grain size distribution. Presents compiled data in 11 tables and 83 plates. Discusses results relative to the relation between sediment load and river stage, effect of influent water on sediment concentration, and variations of velocity and sediment concentration with depth. Observations were made at the Mayersville Discharge Range below Cairo, Ill.
 21. Study of materials in transport, passes of the Mississippi River. U. S. Waterways Expt. Sta., Hydraulic Res. Center, Tech. Memo. 158-1, 36 pp., illus., Sept. 1, 1939.

Describes and presents results of an investigation to ascertain the quantity and characteristics of the solid material transported through the passes of the Mississippi River and to determine miscellaneous data as to hydraulic conditions, discharge, and dissolved content of water in the passes. The investigation was undertaken to clarify the problems involved in future plans for the refinement of the improvement works in the passes.
 22. Report on sediment investigations, Mississippi River low water of 1939. U. S. Waterways Expt. Sta., Hydraulic Res. Center, Tech. Memo. 120-2, 5 pp., tables and graphs, May 21, 1940.

Reports results of analyses of water samples taken from the Mississippi River during the low water period of 1939. Suspended matter and dissolved constituents were analyzed. The purpose was to determine the amount of sediment in the water, grain size distribution, and amount and chemical composition of dissolved material.
 23. Model study of plans for channel improvement in the vicinity of Boston Bar, Mississippi River. U. S. Waterways Expt. Sta., Hydraulic Res. Center, Tech. Memo. 159-1, 53 pp., illus., May 25, 1940.

A model study of the Mississippi River in the vicinity of Boston Bar nine miles above Cairo, Ill. The study was to determine the best system of regulating works to provide a stable channel over Boston Bar crossing, or to realign the channel in a more favorable position. Notes method to prevent shoaling in the channel over Boston Bar crossing.
 24. Model appurtenances and devices; measurement of silt deposition. U. S. Waterways Expt. Sta. Bul., vol. 3, no. 2, p. 13, June 15, 1940.

Describes details of the design of a device, employed in model studies involving problems of deposition and transportation of silt, to make determinations of the quantity of silt deposited on the fixed bed of a model.
- UNWIN, W. C. See Buckley, A. B., 1.
- UPPAL, HARBANS LAL.
1. Pressures under a model of Panjnad weir and under the prototype. Punjab Irrig. Res. Inst., Res. Pub., vol. 2, no. 11, 6 pp., illus., 1936.

Presents results of investigations relative to the pressures under a model of the Panjnad weir, correlated with results in the prototype. Includes a discussion on the effect of silt additions upstream of the model on the percentage effective pressure.
 2. (and Gulati, Thakar Dass). A study of river conditions at Khanki headworks by means of a model and an investigation of methods for obtaining uniform distribution of flow and minimum silt entry into the canal. Punjab Engin. Cong., Minutes of Proc., vol. 27, pp. 173-188, illus., 1939.

Describes and presents results of model studies of the Khanki headworks, River Chenab, India, preparatory to the remodelling of the headworks to insure a uniform flood discharge over the weir and to permit the minimum quantity of silt to enter the canal.
 3. A comparison of further results of model experiments and observations on the prototype. India. Cent. Bd. Irrig., Pub. 29, pp. 56-61, illus., 1943.

Classifies the various types of models. Describes each type of model, nature of the problem, and the circumstances under which the model was examined. Data and results are given. Correlation between observations obtained from the prototype and results from models showed a close agreement.
 4. An improved form of Uppal sampler for determining suspended and rolling silt in a stream of water [abstract]. India. Cent. Bd. Irrig., Pub. 31, p. 85, 1944.

The sampler is of the straight flow-through type with shutters operated by a rod.
 5. Shingle and silt excluders and ejectors. India. Cent. Bd. Irrig., Pub. 31, pp. 100-102, illus., 1944.

Deals with investigations in models concerned with methods of excluding shingle and sand carried by rivers from the canal system with particular reference to the headworks of the Western Jumna Canal. Develops a new design of shingle excluder. Shows that projecting the slab of the ejector tunnels beyond the mouth of the tunnels and making the noses of the piers, at the mouth, of cut-water shape, tend to increase the efficiency of the ejectors. Basic experiments conducted in the glass flume for silt ejectors are mentioned.
 6. A study of the behaviour of the armoured spurs on the River Beas and a comparison of the results of model experiments and observations on the prototype [abstract]. India. Cent. Bd. Irrig., Pub. 31, p. 49, 1944.

Describes model investigations of the River Beas in the reach where it was eroding its left bank. Observations of the prototype, forecasts from the model, and comparisons are dealt with.
- UPSTREAM ENGINEERING CONFERENCE.
1. Headwaters control and use. 261 pp., illus. Washington, U. S. Gov. Print. Off., 1937.

Contains papers and discussions presented at the Upstream Engineering Conference held in Washington, D. C., Sept. 22 and 23, 1936. The various papers summarize fundamental principles and their application in the conservation and utilization of waters and soils throughout headwater areas.
- UTAH SPECIAL FLOOD COMMISSION.
1. Torrential floods in northern Utah, 1930. Utah Agr. Expt. Sta., Cir. 92, 51 pp., illus., 1931.

In the preliminary report of the Committee on Flood Control Works a brief description of the effects of floods in Utah during July, August, and September 1930, on conditions of erosion and the deposition of erosional debris is given, and recommendations are made to construct a

UTAH SPECIAL FLOOD COMMISSION. - Continued system of barriers and controls which will confine subsequent floods within prescribed limits causing debris deposition on areas set aside for that purpose. The report of the Committee on Causes and Prevention Measures includes a discussion of the character of the Davis County floods, noting conditions of erosion and deposition. Factors contributing to flood flows are considered, and results are given of an investigation of both ancient and recent deposits which record the streams' activities in the Center-ville-Farmington section.

VAIDHIANATHAN, V. I.

1. An optical lever siltometer. Punjab Irrig. Res. Inst., Res. Pub., vol. 5, no. 1, 17 pp., illus., Jan. 1933.

Describes an optical lever siltometer devised for the accurate study of the size distribution of silts. Discusses the theory on which the apparatus is based by which observations enable a silt distribution curve to be obtained. Results of experiments to test the working of the siltometer are shown in siltograms and curves. Sources of error and precautions necessary to obtain accurate results are considered.

2. The transmission coefficient of water in natural silts. Punjab. Irrig. Res. Inst., Res. Pub., vol. 5, no. 2, 12 pp., illus., Jan. 1934.

Deals with the experimental determination of the transmission coefficient of canal-bed silts in relation to their distribution.

VALENTINI, C. See Chiera, A., 1.

VAN DER VEEN, H. See also Todd, O. J., 10.

1. A plan for reducing the width of the Yellow River at the crossing with the Peking-Hankow Railway Line. Assoc. Chinese and Amer. Engin. Jour., vol. 5, no. 5, pp. 1-9, illus., May 1924.

Deals with a proposed plan to contract the Yellow River at the Peking-Hankow Railway crossing. Includes a discussion on the probable conditions of scour consequent to the construction of the training works.

2. The improvement of the Yellow River. Assoc. Chinese and Amer. Engin. Jour., vol. 5, no. 8, pp. 1-8, illus., Aug. 1924.

Deals with existing conditions of and proposed improvements to the Yellow River. Describes characteristics of stream; conditions of transportation and deposition of sediment, changes in stream course, plain-building, and delta formation; and dike breaching. Examines present methods of river control to show their ineffectiveness as defense works, and existing and proposed bank protection works.

3. The improvement of the Yellow River. Assoc. Chinese and Amer. Engin. Jour., vol. 6, no. 9, pp. 9-21, illus., Sept. 1924.

Deals with proposed training works for the improvement of the Yellow River. Describes regimen of stream, conditions of sediment transportation and deposition, character of bed and banks, and principles of stream energetics. Discusses effect of stream contraction on conditions of scour and deposit. Gives a proposed plan of river improvement and the silt problem involved.

VAN DRIEST, EDWARD R. See also Dobbins, W. E., 1; Kalinske, A. A., 1; Vanoni, V. A., 4.

1. The control of silt deposits near condenser intakes at a steam power plant. 43 pp. Aug. 1937. Unpublished thesis (M. S.) - State University of Iowa; [abstract], Iowa Univ., Studies in Engin., Bul. 19, p. 59, May 1939.

A model study of a section of the Des Moines River to investigate the problem of silt deposition at the condenser intakes of a steam power plant.

2. Experimental investigation of turbulence diffusion - a factor in transportation of sediment in open-channel flow. Jour. Appl. Mechanics, vol. 12, no. 2, pp. A91-A100, illus., June 1945.

Investigates experimentally turbulence diffusion in open-channel flow by photographing the spread of globules formed by an immiscible fluid being injected in water. Reviews the theory concerned with the problem. The data pre-

sented can be fitted to two types of curves: One curve corresponding to a power-correlation law, and the other to an exponential-correlation law.

Discussion: A. A. KALINSKE, (Jour. Appl. Mechanics, vol. 13, no. 4, p. A304, illus., Dec. 1946), notes that he had been carrying on experimental investigations concerning the subject of the author's paper, and that there was an agreement of conclusions reached. H. W. LIEPMANN, pp. A304-A305, comments on the evaluation of measurements by using the exponential-correlation law. Treats of the problem of a "regular turbulence" pattern indicated by the periodic wanderings of globules. Makes various other comments concerned with the problem. J. M. ROBERTSON, pp. A305-A306, comments on use of eddy diffusivity in prediction of manner of distribution of suspended sediment. Notes methods of determining the diffusion coefficient. THE AUTHOR, p. A306, makes various comments on the discussions mentioned above.

VAN FRANK, P. R.

1. Random notes on improvement of rivers. 200 pp., illus. Memphis, Tenn., U. S. Engin. Dept., 1933.

Represents a compilation of random notes on improvement of rivers with movable bottoms for navigation and refers to cause of abandonment of attempt to improve the Arkansas River by permanent structures. Includes such subjects as: sources of materials, movement of materials, scour and fill, longitudinal profile, dikes, training walls, bends and bars, use of models, regulating works, types of works, dredging, rules for curves, and improvements. Cites various authors and references, thus giving a comprehensive survey of this field. Gives running extracts from various publications.

VAN KÁRMÁN, TH.

1. Some aspects of the turbulence problem. Internatl. Cong. Appl. Mech., Proc., (1934) 4, pp. 54-91, illus., 1935.

Discusses the physical nature of the phenomenon and presents some practical applications of the theory of developed turbulence. Includes a brief discussion on sediment transfer in turbulent flow.

VAN LEEER, BLAKE R.

1. The Research Institute for Hydraulic and Hydro-electric Structures. Mech. Engin., vol. 50, no. 8, pp. 607-610, illus., Aug. 1928.

Gives an account of the plans and activities of the Forschungsinstitut für Wasserbau und Wasserkraft, with a description of the experimental field of this German institution and a summary of its technical accomplishments. A description of the Oberrach experimental field is given and problems of stream erosion and the transportation and deposition of sediment to receive immediate investigation are noted.

VAN NIEUWENBURG, C. J.

1. (and Schoutens, Wa.). A new apparatus for a rapid sedimentation analysis. Amer. Ceramic Soc. Jour., vol. 11, pp. 696-705, illus., 1928.

Describes a new apparatus for the rapid and reliable determination in sedimentation analysis of the cumulative distribution curve of a particle size.

VANONI, VITO A. See also Brown, C. B., 12; Maddock, T., Jr., 1.

1. Some experiments on the transportation of suspended load. Amer. Geophys. Union, Trans., vol. 22, pt. 3, pp. 608-620, illus., 1941.

Presents results of experiments conducted by the Cooperative Laboratory of the U. S. Soil Conservation Service and the California Institute of Technology on the transportation of a suspended load of sediment by water. Discusses analytical development of the theory of transportation of suspended load, experimental procedure, results of velocity distribution and sediment distribution and effect of sediment on velocity, and gives conclusions.

Discussion: W. W. RUBEY, p. 620, asks for more information concerning an increase in velocity of flow due to the adding of sediment

- to clear water. A. A. KALINSKE, pp. 620-621, gives a different opinion on aspects of sediment transportation than those presented by the author. C. S. JARVIS, p. 621, presents a question to the author concerning an increase in velocity due to the addition of sediment.
2. Velocity distribution in open channels. *Civ. Engin.*, vol. 11, no. 6, pp. 356-357, illus., June 1941. Discusses velocity distribution in open channels. The fact that in streams the maximum velocity does not occur at the surface precludes the possibility that the velocity distribution is strictly logarithmic. The relation discussed indicates a striking similarity between observed distributions and those following logarithmic law and offers reasonable justification for the use of this law in calculating some of the performance characteristics of natural streams.
 3. Experimental evidence on the effect of suspended sediment on flow-characteristics. *Amer. Geophys. Union, Trans.*, vol. 23, pt. 1, p. 60, 1942. Describes the results of laboratory experiments which show that the addition of suspended load to a flow tends to reduce the apparent friction factor, thus causing the flow velocity to increase. The problem is analyzed in terms of the turbulent transfer-mechanism, and the action of the sediment in increasing the flow velocity is explained by its effect in reducing the turbulence. Evidence is presented that actions similar to those observed in water flows carrying suspended loads are also found in other fluid flows in which a density gradient exists. Concentration gradients across flows are discussed, particularly in regard to their possible relation to the secondary currents existing in the natural streams.
 4. Transportation of suspended sediment by water. *Amer. Soc. Civ. Engin., Trans.*, vol. 111, pp. 67-102, illus., 1947; also in *Amer. Soc. Civ. Engin., Proc.*, vol. 70, no. 6, pp. 793-828, illus., June 1944. Describes flume measurements of sediment and velocity distributions for various values of slope of channel, rate of flow, and suspended-load size and amount. Compares sediment-distribution measurements with theoretical distribution which has been derived with the idea that the coefficient for the turbulent transfer of momentum is the same as the coefficient for the turbulent transfer of suspended sediment. Gives the various findings of the study. Discussion: RALPH W. POWELL, pp. 103-106, comments on double spiral flow and believes it is the cause of unequal distribution of suspended load and not a result of it. Discusses the reduction in resistance to flow which accompanies the presence of sediment. E. R. VAN DRIEST, pp. 106-109, points out that the problem of suspension of sediment by flowing water is but one of three turbulent transfer problems and comments on these transfer problems. Considers the fact that the velocity-distribution data did not fall in a straight line when plotted on semilogarithmic paper. WESTON GAVETT, pp. 109-111, treats velocity-distribution profiles. BERARD WITZIG, pp. 111-114, considers suspended load and bed load and notes that the results of the paper should not be applied indiscriminately to the total suspended load. Discusses subjects such as saltation, side-wall effect, depth-width ratio, channel roughness, slip between fluid and particles, etc. Notes need of further research on channel roughness or resistance. A. A. KALINSKE, pp. 114-116, makes various criticisms of points brought out by Dr. Vanoni and gives the results of a series of experiments made at the Iowa Hydraulic Laboratory, University of Iowa, on the transportation of fine sediment in a flume. PAUL F. NEMENYI, pp. 116-125, comments on the subject of secondary currents or secondary circulation, and on work by L. Prandtl, Max Möller, M. A. Welikanov, Hugh Casey, Mr. Terada, and others on this problem. THE AUTHOR, pp. 125-133, treats of secondary circulation and hopes that it will not become an important factor in the problem of sediment suspension. Makes various comments on facts brought out by the discussers and gives additional facts concerning the problem of transportation of suspended sediment by water.
 5. Development of the mechanics of sediment transportation. *Fed. Inter-Agency Sedimentation Conf.*, Denver, 1947, *Proc.*, pp. 209-222, illus., 1948. Outlines briefly the history and development of the mechanics of sediment transportation. Indicates the information in this field available to the engineer and sedimentation specialist. The work of various researchers in the field is given. Various sediment transportation formulas are discussed. Suggests lines of research which will furnish information needed to solve many sedimentation problems. Discussion: M. A. MASON, pp. 222-223, comments on the need for more financial support necessary for a well-conceived program in sediment transportation research. PARKER D. TRASK, p. 223, points out the value of the knowledge of basic laws governing the erosion and deposition of sediments. HANS A. EINSTEIN, pp. 223-224, remarks on the direction of research in this field. Comments on the idea that the movement of any one particle is practically independent of other particles and may be fully described as a function of the flow. Believes we will in a short time be able to calculate the transport of material which moves partly in suspension and partly as bed load.
- VAN ORMAN, CLARE R.
1. Preventing bank caving by deflecting river current. *Engin. and Contract.*, vol. 68, no. 3, pp. 123-124, illus., Mar. 1929. Describes details of construction and results of use of a diversion jetty and lighter spur jetties to deflect river current and prevent bank caving on the Amite River, just below the mouth of the Comite River, La.
- VAN ORNUM, J. L.
1. Regulation of rivers. 393 pp., illus. New York, McGraw-Hill Book Co., 1914. Deals with various problems concerned with the regulation of rivers. Treats such subjects as rainfall and runoff, forest influence, relation of storage reservoirs to the control of runoff, significance of erosion, transportation and accretion, methods of river improvement, investigations and surveys, principles of regulation, the protection of erodible banks, dredging, levees, and control of current.
- VAN ORSTRAND, C. E.
1. Note on the representation of the distribution of grains in sands. *Natl. Res. Council, Div. Geol. and Geog., Com. on Sedimentation, Rpt.* 1924, pp. 63-67, illus., 1925. Presents some rough calculations of the value of Pearson's frequency functions which are a means of representing the observed distribution of grains in sand.
 2. Some recent investigations by physicists that have a bearing on problems in sedimentation. *Natl. Res. Council, Div. Geol. and Geog., Com. on Sedimentation, Rpt.* 1924, pp. 55-62, 1925. Reports briefly on recent contribution by physicists that bear on problems in sedimentation. Notes work of various investigators on the measurement of forces causing flocculation and deflocculation of fine solid particles immersed in liquids, temperature changes caused by the contact of fine powders with liquids, the aggregation of ultra-microscopic particles suspended in a gaseous medium, the distribution of particles in colloidal suspension, the fall of spheres through gases, the effect of immersion medium on apparent size of particle, dynamics of capillary flow, the coloring of the sea and the effect upon color of small quantities of suspended matter, and the speed of sound in water.
 3. Some recent investigations by physicists that have a bearing on problems in sedimentation. *Natl. Res. Council, Div. Geol. and Geog., Com. on Sedimentation, Rpt.* 1925-26, pp. 33-40, illus., 1926. Presents a general quantitative description of the process involved in the subsidence of small

- VAN ORSTRAND, C. E. - Continued particles and discusses methods developed for the determination of the distribution of diameters of particles based on measurements of the subsidence of the particles in a liquid.
- VAN WINKLE, WALTON.
- (and Eaton, Frederick M.). The quality of the surface waters of California. U. S. Geol. Survey, Water-Supply Paper 237, 142 pp., illus., 1910. Presents data resulting from investigations on the quality of surface waters of California. Dissolved and solid load determinations are given for streams and a few lakes in the northern, central, and southern California coast basins, the Sacramento and San Joaquin River basins, and the San Francisco Bay, Sierra Nevada and central great basins. Watershed conditions affecting the quality of stream waters, water usage possibilities, and a summary and analysis of results of the investigations are given.
 - Quality of the surface waters of Oregon. U. S. Geol. Survey, Water-Supply Paper 363, 137 pp., illus., 1914. Presents results of turbidity, and dissolved- and suspended-load determinations of surface waters in the Sacramento, Owyhee, Northern California-Klamath, Lower Snake, Willamette, and lower and middle Columbia River basins, and in the Northern Great and Oregon Coast basins of Oregon (1911-12). General features of stream and lake waters are discussed. Considers, with reference to the characteristics of the surface waters of Oregon, conditions influencing quality, average chemical composition, and geochemical classifications. Data are given on rates of denudation by rivers of Oregon and the industrial and irrigational value of river and lake waters.
 - Quality of the surface waters of Washington. U. S. Geol. Survey, Water-Supply Paper 339, 105 pp., illus., 1914. Describes the quality of surface waters of Washington, 1910-11. Includes a discussion of the method of analysis of composite samples, and the geochemical classification of natural water depending on the concentration of waters and on the relationship between radicles in water and types of rock from which they are dissolved. Describes the basin, locality of sampling, dissolved- and suspended-load determinations, turbidity, and other physical characteristics of the waters of the Wood Creek, Skagit, Cedar, Green, Chehalis Wynoochee, Spokane, Okanogan, Wenatchee, Yakima, Naches, Snake, Klickitat, and Columbia Rivers. Data are given on the average chemical composition of the surface waters of Washington, the relative amounts of suspended and dissolved loads of streams, and the amounts of denudation by streams. The effect of precipitation, wind-borne material, forestation, and the character of rocks on the quality of surface waters, are other topics considered.
- VARNEY, FRED M.
- A marine coring instrument—its construction and use. Amer. Geophys. Union, Trans., vol. 16, pt. 1, pp. 264-266, illus., 1935. Describes the construction and use of a bottom-sampler developed recently to procure cores several feet long.
- VAUGHAN, T. WAYLAND.
- The geologic work of mangroves in southern Florida. Smithsonian Inst., Misc. Collect., vol. 5, pt. 4, pp. 461-464, illus., 1910. Describes mangroves and the role played by their roots in catching and holding debris washed among them by currents and waves. Notes the method by which the mangroves build new land.
 - Abstract of Sven Odén's work on the determination of the effective radius of particles by their rate of settling in a fluid. Natl. Res. Council, Div. Geol. and Geog., Com. on Sedimentation, Rpt. 1922-23, pp. 41-49, 1923. Summarizes the work of Sven Odén, on the determination of the effective radius of particles by their rate of settling in a fluid, based on Stokes' law. The validity of Stokes' law as applied to sediments, rates of fall of particles as affected by temperature, distance of fall, and degree of concentration in a fluid are discussed. Laboratory apparatus and mathematical procedure for determining the rate of fall are described.
- VAUGHN, R. L. See Heindenstam, A. V. H. von, 1; Howard, G. W., 1.
- VEATCH, A. C.
- Geology and underground water resources of northern Louisiana and southern Arkansas. U. S. Geol. Survey, Prof. Paper 46, 389 pp., illus., 1906. Deals with the geology and underground water resources of northern Louisiana and southern Arkansas. Includes a discussion on the method of formation, rate of growth, and effects of Great Raft of the Red River, origin of lakes in the Red River Valley, and the deflection of the Red River below Alexandria, La.
- VELIKANOV, M. A.
- General equation determining deformations of erodible stream bed. Sci. Res. Inst. Hydrotechnics, Trans., vol. 6, pp. 76-79, 1932. In Russian with English abstract. Translation on file at the U. S. Soil Conservation Service, Washington, D. C. Presents a general differential equation for the representation of stream-bed deformations.
 - Theory of probability applied to analysis of sedimentation of silt in turbulent streams. Sci. Res. Inst. Hydrotechnics, Trans., vol. 18, pp. 55-56, 1936. In Russian. Translation on file at the U. S. Soil Conservation Service, Washington, D. C. Presents a theory, based on experimental investigations, relative to the settling of silt particles in turbulent streams. Develops a triple integration formula employing distribution of silt in cross-section, velocity of fall, height from bottom, and time as factors.
- VELSCHOW, FRANZ A. See Crowell, J. F., 1.
- VENABLE, WILLIAM MAYO. See Stevens, J. C., 6.
- VERNON, ROBERT O.
- Tributary valley lakes of western Florida. Jour. Geomorph., vol. 5, no. 4, pp. 302-311, illus., Dec. 1942. Discussion of stream history in western Florida and of the development of clear-water tributary lakes along the Choctawhatchee and Apalachicola Rivers. Rapid sedimentation in the main valleys has caused lakes to form in the lower parts of the tributary valleys, such as Dead Lake along the Chipola River, and similar lakes along Holmes, Pinelog, and Wrights Creeks. Water of Dead Lake is 5-10 ft. deeper than water of Apalachicola River, and bottom is 25 ft. lower than flood plain of Apalachicola. Similar conditions are found in tributaries of Red, Mississippi, and Ouachita Valleys in Louisiana.
- VERNON-HARCOURT, LEVESON FRANCIS.
- Fixed and movable weirs. Inst. Civ. Engin., Minutes of Proc., vol. 60, pp. 24-42, 1880; [abstract], Engineering, vol. 29, pp. 101-102, Jan. 30, 1880. Describes the construction and use of fixed and movable weirs in India. Notes the silting up of rivers and extension of subsoil drainage as causes of floods in river valleys. Discusses flood control by bank raising or by increasing the depth and width of channels.
 - The River Seine [extract]. Engineering, vol. 41, pp. 179-180, Feb. 19, 1886. Describes hydrology of the river, inland works to aid navigation, weirs, and estuary works. Gives historical development of canalization from low to greater navigable depths by means of locks and weirs. Notes natural barriers to navigation due to shallow winding channel, shifting of sand banks, current, storms, etc. Training walls of chalk prolonged yearly endangered approaches to Havre due to accretions. Author suggests new method of extension of walls.
 - The principles of training rivers through tidal estuaries, as illustrated by investigations into the methods of improving the navigation channels of the estuary of the Seine. Roy. Soc. London, Proc., vol. 45, pp. 504-524, illus., Mar. 28, 1889.

Discusses experiments made to determine the most satisfactory principles for training rivers through estuaries with silt-bearing currents. Describes, in detail, procedure and results of investigations, carried on at intervals during more than 2 yr., with reference to proposed extensions of training works in the Seine estuary.

4. Investigations into the effects of training walls in an estuary like the Mersey [abstract]. Roy. Soc. London, Proc., vol. 47, pp. 142-144, 1890.

Deals with model studies to determine the effects of training walls in an estuary like the Mersey. Notes that training walls in the lower estuary combined with dredging offer the best prospect of forming a stable and deepened channel across the bar.

5. The training of rivers, illustrated by the results of various training-works. Inst. Civ. Engin., Minutes of Proc., vol. 118, pp. 1-46, illus., 1894.

Summarizes the results of observations concerning the transport of sand by running water in connection with the Manchester Ship-Canal Bills of 1883-85. Describes an apparatus with glass sides devised in order to observe the behavior of sand. Notes that the actual quantity of sand transported depends on the size of individual particles and depth of water for the investigation which involves the fifth power of velocity.

Discussion: G. F. DEACON, pp. 93-96, compares and contrasts the results of training works in a variety of rivers subject to different physical conditions. Presents results of laboratory experiments in connection with training works in the Mersey estuary, relative to the transport of sand and silt under varying velocities of flow. Notes weight of sand transported was proportional to the fifth power of the surface velocity.

6. Characteristic particulars about a tidal river, with application to the Rivers Hugli and Mersey. I. Indian Engin., vol. 24, pp. 186-189, illus., Sept. 17, 1898.

Discusses the various characteristics of a tidal river with particular reference to the Rivers Hugli and Mersey. Considers the following particulars: Tidal conditions, fresh water discharge, nature and amount of alluvium transported, nature of bed and banks, available navigable depth, form of the estuary or outlet, and the nature of the bars across the navigable channel of the river.

7. Characteristic particulars about a tidal river, with application to the Rivers Hugli and Mersey. II. Indian Engin., vol. 24, pp. 220-221, illus., Oct. 1, 1898.

Compares the physical characteristics of the Rivers Hugli and Mersey. Considers the tidal conditions of the streams, fresh water discharges, amounts of alluvium transported, nature of beds and banks, changes in course, changes in width, cross-sections, available navigable depths, conditions of navigation, form and condition of estuaries, and the nature of the bars across the navigable portions of the streams.

8. The improvement of the Hooghly [letter to editor]. Indian Engin., vol. 25, pp. 218-219, Apr. 8, 1899.

Criticizes the proposed plan of Lindon Bates for the improvement of the River Hugli by extensive dredging and reclamation works.

9. Experimental investigations on the action of sea water in accelerating the deposit of river silt and the formation of deltas. Inst. Civ. Engin., Minutes of Proc., vol. 142, pp. 272-287, 1899-1900.

Discusses experiments concerned with the influence of sea water on the deposition of river silt and delta formation. Treats composition of river silts and substances in solution in river water and sea water. Notes conditions affecting settlement of river silt.

VERWEY, E. J. W.

1. (and Niessen, K. F.). The electrical double layer at the interface of two liquids. London, Edinb. and Dublin Phil. Mag. and Jour. Sci., (ser. 7) vol. 28, no. 189, pp. 435-446, Oct. 1939.

Considers the potential function at the interface of a two-liquid phase about which a small amount of electrolyte is distributed. Notes that the most simple case of an electrical double layer caused by a distribution of potential determining ions consists of two liquids which are in contact with each other.

VETTER, CARL P. See also Corfitzen, W. E., 5.

1. Desilting works for the All-American Canal. West. Construct. News, vol. 10, no. 10, pp. 288-290, Oct. 1935.

Discusses the design of the Imperial Dam and the headworks for the All-American Canal, including the desilting basin composed of six 269 x 769-ft. settling basins arranged in pairs, each with rotary scrapers to remove the settled silt. Note is made of the magnitude of the silt problem in the Imperial Valley and of studies of silt load of the Colorado River. Bed load of the river is negligible, nearly all the material being transported in suspension. The load is divided into coarse load (retained on 300 mesh) and fine load. Only coarse load is removed by desilting works. Desilting works will handle silt until the eventual stabilization of the river bed below Boulder and Parker Dams, which will take several decades.

2. Why desilting works for the All-American Canal? Engin. News-Rec., vol. 118, pp. 321-326, illus., Mar. 4, 1937.

Discusses the transportation of suspended silt and bed load by the Colorado River and the necessity of its removal in a desilting works before the diversion of water from the river into the All-American Canal. Includes a discussion of the theory of particle movement in a turbulent stream, and experimental data on silt load, bed load, and the bed of the Colorado including their mechanical analysis. Discusses the relation of mechanical analysis to particle transportation and concludes that bed-load movement is insignificant below Boulder Dam. Observations of retrogression below Boulder Dam are analyzed and estimates made of the daily quantity of silt of various size ranges that would enter the Imperial Reservoir. Various alternative methods of handling silt (dredging, etc.) are compared with the desilting plan finally adopted.

3. Technical aspects of the silt problem on the Colorado River [abstract]. Civ. Engin., vol. 10, no. 11, pp. 698-701, illus., Nov. 1940.

Discusses the research and theory which formed the basis for the design of the desilting works at the head of the All-American Canal. The studies undertaken dealt with the subject of the mechanics of silt transportation and with the effects of Boulder and Parker Dams on the silt content downstream. Details of design of the desilting works are described.

VEZZANI, RENZO.

1. Etudes sur le delta du Po (Studies on the delta of the Po River). Internatl. Cong. Navigation, 15th, Venice, Serv. Hydrographique Italien, pp. 33-356, illus., 1931. In French. Translation on file at the U. S. Soil Conservation Service, Washington, D. C.

Discusses studies by the Hydrographic Bureau on the delta of the Po River in Italy, including propagation of tides, discharge of Po, currents, physical and chemical phenomena of mixture of fluvial and marine waters, division of suspended matter in different branches of the delta, erosion at the mouths, and formation of sand banks.

VIAPPANI, ANTONIO.

1. Practical fluvial hydraulics. Milan, Italy, 1949. In Italian. Translation on file at the U. S. Soil Conservation Service, Washington, D. C.

A guide for technicians who propose to project and execute regulations of rivers and torrents and related protective works. Comments on transport of materials, profile of stream beds, alluvial cones, etc. Discusses characteristics of watercourses, works for controlling fluvial streams, stepped earth levees, protective works in rivers and torrents, and regulation of fluvial currents. Comments on various rivers in Italy are included.

VINCENT, EUGENE.

1. Causes of disease in young salmonoids. U. S. Bur. Fisheries Bul., vol. 28, pt. 2, pp. 907-916, 1908. Deals with causes and means of prevention of and curative measures for diseases in young salmonoids. Notes the effect upon fish life of organic matter and sediment which rising waters carry.

VIOSCA, PERCY, JR.

1. Louisiana wet lands and the value of their wild life and fishery resources. Ecology, vol. 9, no. 2, pp. 216-229, Apr. 1928.

Paper presented before the Ecological Society of America, Kansas City, Mo., Dec. 31, 1925, on the value of wildlife and fishery resources in the Louisiana wet lands. Discusses in particular the disastrous effects on the flora and fauna of the wet areas, of "so-called improvements" to drainage, land reclamation and flood control. Includes 10 paragraphs on the physiography of Louisiana wet lands and describes, in this connection, the conditions of stream erosion and the transportation and deposition of alluvial matter.

VIRGINIA STATE PLANNING BOARD.

1. Natural resources—water resources. Va. State Planning Bd., Rpt., vol. 2, sect. 4, 252 pp., Dec. 31, 1935.

Deals with existing conditions of and proposed improvements to the water resources of Virginia. Describes briefly conditions of silting on flood plains, and chemical characters of the waters of the Potomac, James, Chowman, and Roanoke Rivers, and of tributaries of the York River. Data are given on the silt load of the James River at Richmond and of the Roanoke at South Boston. Estimates silt deposition and life of proposed reservoirs in the James River basin. Results of silt studies in Schoolfield and Walnut Cove Reservoirs on the Dan River are given.

2. Drainage basin studies. Va. State Planning Bd., Rpt., vol. 10, 127 pp., illus., Mar. 1, 1937.

Deals with existing conditions and proposed development of water resources in Virginia. Includes brief notes to the effect that silting may be troublesome under any scheme for power development on the Potomac River however beneficial the silting of flood plains is to agriculture, and that the average silt burden of the James River at Richmond is equivalent to 5.7 acre-feet per annum per 100 sq. miles of drainage area.

VIRGINIA STATE PLANNING BOARD. RIVER BASIN COMMITTEE.

1. Report on the proposed development of the Roanoke River basin. 161 pp., illus. Richmond, 1947.

This, the first of a series of reports contemplated for different river basins in Virginia, is a condensed and interpretive report on the Review Report of the U. S. Corps of Engineers, along with other data. Contains a table showing percentages of loss of storage for various reservoirs in the basins, noting that silting will affect the power-producing capacity very little. Notes that Buggs Island storage will be reduced between 15 and 16 percent within the first 50 yr.

VISENTINI, MARCO.

1. Esperienze sui metodi di misure della torbida fluviale in sospensione (Observations concerning the methods of measuring turbidity in rivers). Ann. Idrologici, pt. 2, 1932. In Italian. Translation on file at the Institute of Hydraulic Research, University of Iowa, Iowa City, Iowa.

Discusses the measurements of suspended material in rivers by the use of the turbimetric bottle and centrifuge by the Hydrographical Institute of the Po. Gives data on turbidity.

2. Alluvial deposits in reservoirs, their importance and the means to lessen or prevent them. Internatl. Cong. on Large Dams, 2(1936) vol. 5, pp. 169-176, illus., 1938; also in Water and Water Engin., Large Dams Sect., vol. 39, pp. 10-13, Sept. 1938.

Presents a compendium of factual data on experimental findings of what is known to date in Italy concerning alluvial deposits in reservoirs

and the transportation of sediment in water-courses. Describes various reservoirs throughout Italy in which alluvial deposits have decreased storage capacities giving location, rate of silting, precipitation, conditions of erosion and types of rock formations on water-sheds. Recommends geologic and engineering studies in river valleys to determine conditions of erosion. Notes the value of reforestation, strengthening of banks, construction of low walls and filters, and other minor constructions useful to consolidate ground surface to prevent silting of the reservoirs.

VLIET, ELMER B. See Tolman, R. C., 1.

VOELCKER, J. AUGUSTUS. See also Buck, Sir E. C., 2; Wallace, R., 1.

1. The agricultural needs of India. Soc. Arts Jour., vol. 40, no. 2056, pp. 554-564, Apr. 1892.

Describes agricultural conditions in India. Includes two paragraphs noting areas of "usar" land impregnated with soda-salts, or "reh," possibly caused by increased capillarity of the soil after the clearing away of forests and the introduction of canals. Notes the possibility of reclaiming "usar" land by flooding with canal silt.

Discussion: SIR ARTHUR COTTON, pp. 570-571, comments on the economics of irrigation works in Madras, Tanjore, Godavery, and Punjab, India, where silt-laden irrigating waters increase fertility of the soil of inundated lands. Stresses the need of using river water which contains fertilizing materials.

VOGEL, HERBERT D. See also Kramer, H., 2; Matthes, G. H., 6; Nichols, K. D., 1.

1. Control of floods in the alluvial valley of the lower Mississippi River—basic data, Mississippi River. 71st Cong., 3d sess., H. Doc. 798, vol. 1, pp. 59-137, illus., 1931.

Presents various basic data on the geology, topography, and hydrography of the lower Mississippi River basin. Includes data on changes in river widths and depths, and on the amount and conditions of sediment transportation and deposition in the river.

2. Research at waterways experiment station. Military Engin., vol. 24, no. 136, pp. 331-335, illus., July/Aug. 1932.

Discusses methods and results of work during the first 2 yr's. operation of U. S. Waterways Experiment Station. Model studies were made of the Illinois River, the Ohio River at Cincinnati, cut-offs on the Mississippi River, levees south of Eagle Lake, Miss., Walkers Bar above Paducah, Ky., on the Ohio River, and the St. Lucie Canal.

3. (and Thompson, P. W.). Flow in river bends. Civ. Engin., vol. 3, no. 5, pp. 266-268, illus., May 1933.

Refutes the helicoidal theory of flow at river bends and gives experimental evidence of a new theory. Discusses helicoidal theory, formation of bars on convex side of the bend, and caving of concave banks; experiments carried out at U. S. Waterways Experiment Station on models of Mississippi at Slough Bend, part of Island No. 9, reach model, and experimental technique employed; and use of floating objects, such as dyes, and oat grains to show flow lines. Oat grain shows direction of both bed-load movement and water. Surface floats cross to the concave side and to regions of high velocity. Bottom currents are essentially parallel to each other and to bank lines but the bed load moves across to the convex side of the bend, due to differential water pressure, i. e., "turbulence in direction of decreased velocity" (Prof. J. B. Leighly). Explains formation of the deposit on the convex side.

4. Movable bed-models. Amer. Geophys. Union, Trans., vol. 14, pp. 509-512, June 1933.

Presents a brief outline of methods of design and utilization of moveable bed models to aid in the solution of problems relative to river and harbor improvement. Problems of scour, deposition, and transportation of material in suspension and as bed load can be studied in movable bed-models. Application of the model

study for improvement of the Mississippi River in the vicinity of Brooks Point, Mo. is described.

5. Experiments with movable bed river models.

Military Engin., vol. 25, no. 142, pp. 313-316, illus., July/Aug. 1933.

Discusses the use by the U. S. Army Engineers of scale models in which sand movement on the bed of the model will be similar to bed-load and silt movement in the prototype. Applies this method to studies of Island No. 9 and Race Track Towhead, two important reaches of the Mississippi River, the former being about Donaldson Point Crossing at Mile 56 below Cairo. Mathematical calculations involved in calibrating scale models are also discussed.

6. Movement of bed load in a forked flume. Civ.

Engin., vol. 4, no. 2, pp. 73-77, Feb. 1934.

Reviews the work of previous experimenters in the field. Outlines the model experiments conducted to date at the U. S. Waterways Experiment Station. An effort was made to have the results applicable to conditions in nature. The value of an experiment of this nature is to determine the silt-carrying capacity of a small branch which leaves the main stream to rejoin it below, after following a shorter course than the main stream. Conclusions are drawn for model runs completed and recommendations are made as to future procedure for the continuation of these studies.

7. Sediment-studies at the United States Waterways

Experiment Station. Amer. Geophys. Union,

Trans., vol. 15, pp. 466-468, June 1934.

Describes field investigations and laboratory studies by the U. S. Waterways Experiment Station on the transportation of sediment by the Mississippi River. Describes object and scope of studies on investigations, prior to 1930, of material in suspension in the lower Mississippi; on sediment investigations on the Mississippi River and the tributaries, 1930-31, and probable rate of silting of proposed flood control reservoirs; on characteristics of the material composing the bed of the Mississippi, bed-load movement, and distribution of suspended matter in a stream cross-section; and on the transportation by streams of soils in suspension.

8. Practical river laboratory hydraulics. Amer. Soc.

Civ. Engin., Trans., vol. 100, pp. 118-144, illus.,

1935; also in Amer. Soc. Civ. Engin., Proc., vol. 59, no. 9, pp. 1413-1439, illus., Nov. 1933.

Summarizes available data and describes proven methods applicable to the solution of stream hydraulic problems in the laboratory. Presents a brief history of hydraulic laboratory practice. Discusses conditions of hydraulic similitude in models, problems in a river hydraulics laboratory involving gravity as a controlling factor, and problems involving bed and wall friction as factors. Movable-bed model studies are considered. Conditions for the production of turbulence in open-channel models are discussed. Describes facilities and equipment necessary in a modern hydraulic laboratory, and classifies model types. General types of problems which may be successfully undertaken in hydraulic laboratories are noted. Discussion: LORENZ G. STRAUB, pp. 145-151, notes the limitation of applicability of the mechanics of similitude in the study of hydraulics. States that the earth's gravitation forces, friction between fluid particles, and capillary forces, are the most important physical forces causing fluid motion. Gives equations for determining the model law to be followed when movements in prototype and model are influenced by only one type of physical force. Discusses the necessity of geometrical distortion in designing models of large alluvial rivers with fine bed materials, and points out advantages and disadvantages of vertical distortion in models. PAUL W. THOMPSON, pp. 151-155, considers turbulence, the adjustment of roughness, and distortion in open channel models. RALPH W. POWELL, pp. 155-159, offers several theoretical considerations

which might lead to a satisfactory formula for channel flow and to a true law of model similarity. K. D. NICHOLS, pp. 159-163, describes an improved method for the selection of sand in movable-bed models in order to insure adequate movement. FRANK W. EDWARDS, pp. 163-165, considers Vogel's formula for discharge in the model of a river, the selection of proper scales in a model so that conditions of gravity and friction may be considered, and the feasibility of controlling within limits the roughness factor in the model. I. H. PATTY, pp. 166-168, describes methods employed at the U. S. Waterways Experiment Station for the derivation of a scale to determine the time relationship for movable-bed models. CHARLES S. BENNETT, pp. 168-170, describes a model study used to determine the effect of several low overflow dams upon stages of the Miami River at Dayton, Ohio. V. V. TCHIKOFF, pp. 170-175, considers the question of hydraulic similitude in a model based on conditions of silt transportation in the model channel and in the channel of the prototype in nature. SAMUEL SHULITS, pp. 175-177, considers Vogel's formulas for discharge, turbulent flow, and tractive force in a model of a river. CHARLES D. CURRAN, pp. 177-178, comments upon the relative value of quantitative and qualitative results of model studies. J. B. EGIAZAROFF, pp. 178-180, comments upon the value of the criterion for turbulent flow and the conditions to be met in designing river models with movable beds. THE AUTHOR, pp. 180-184, comments on discussions mentioned above, and notes progress of hydraulic model studies.

9. Hydraulic laboratory results and their verification

in nature. Amer. Soc. Civ. Engin., Trans.,

vol. 101, pp. 597-613, illus., 1936.

Discusses principles in the verification of the reliability of results obtained in hydraulic model studies at the U. S. Waterways Experiment Station, Vicksburg, Miss. Verification was accomplished by (1) subjecting movable-bed models to "moulded-bed" or "flat-bed" runs, (2) field verification of movable-bed models by comparison of bed configuration in model with prototype or comparison of model predictions with prototype development, and (3) transference of small-scale model results to results of a large-scale model of the same prototype. Describes examples of each type of verification: Brooks Point, Fort Chartres, Point Pleasant, Morrison Towhead, Stewarts Bar, Walkers Bar, and Island No. 9, models. Cut-off studies in models of Greenville Bends, and observations corroborating results of hydraulic flume tests on tractive force and bed-load transportation are described.

Discussion: W. F. HEAVEY, pp. 614-615, cites examples supporting Vogel's contention that model studies find verification in natural action. Describes briefly studies to predict behavior of submerged sills in the St. Clair River and to corroborate the theory as to the reason for failure of the concrete caisson breakwater at Milwaukee, Wis. PAUL S. REINECKE, pp. 616-618, supports Vogel's contention relative to the applicability of hydraulic laboratory results to natural conditions. Makes reference to tests on Morrison Towhead and Island No. 9 (lower Mississippi) models relative to stream contraction versus stream dredging. MORROUGH P. O'BRIEN, pp. 618-620, notes quantitative comparisons with natural conditions of results obtained in models by experimenters in France, England, and the United States. JOHN A. JAMESON, JR., pp. 620-622, notes studies and presents certain observations on the limits of transferability of results obtained in the Hydraulic Laboratory of the University of California. SAMUEL SHULITS, pp. 625-627, notes the necessity of accurate application of quantitative results of model studies to predict behavior of prototypes in nature. Successful application of Schoklitsch bed-load formula to several European rivers is noted. THE AUTHOR, pp. 627-629, notes the

VOGEL, HERBERT D. - Continued

development of hydraulic laboratories in the United States. Discusses circular letters which were sent to various hydraulic laboratories to obtain information on model tests.

10. Protection of beds and banks of inland waterways, deep water channels and drainage canals. Perm. Internatl. Assoc. Navigation Cong., Amer. Sect., 8 pp., illus., Nov. 1, 1940.

Discusses conditions necessitating, and describes briefly various types of works for the protection of beds and banks of rivers, deep-water channels, and drainage canals.

VOGT, ALEXANDER.

1. Schlammtransport durch schwimmende Heber-Bagger (Sediment transportation by means of a floating lift-dréddger). *Fördertechnik u. Frachtverkehr*, vol. 20, pp. 454-457, Dec. 23, 1927. In German. Translation on file at the U. S. Soil Conservation Service, Washington, D. C.

Discusses the removal of silt from dams, reservoirs, debris basins, river mouths, and harbor basins for deposition on land for purposes of irrigation and fertilization. This is accomplished by floating, movable lifting power, in which the natural incoming flow of the reservoir is made use of for work of transportation or an artificial incoming flow is created by silt-pumps. Gases in the mud are automatically ejected by waste siphons and conducted into the open or used profitably.

VOINOVICH, P. A.

1. (and Dementiev, M. A.). Equation of erosion. *Sci. Res. Inst. Hydrotechnics, Trans.*, vol. 6, pp. 80-102, 1932. In Russian with English abstract. Translation on file at the U. S. Soil Conservation Service, Washington, D. C.

Refers to a preliminary series of experiments to determine the extent of Exner's equation in representing the process of deformation of the bed when silt is carried as bed load.

VOLOBUYEV, V. R.

1. Method of a continuous mechanical analysis with a siphonic sedimentometer. *Pedology (n. s.)*, vol. 30, no. 1, 1935. In Russian. Translation on file at the U. S. Soil Conservation Service, Washington, D. C. Describes a proposed method for continuous mechanical analysis of soil based upon the principle of hydrostatic equilibrium in communicating vessels. A siphonic sedimentometer is used as an aid. The method was given a close examination and an apparatus for the simultaneous analysis of a large quantity of samples is being constructed with an automatic registrator of the results.

VON ENGELN, OSCAR DIEDRICH. See Engeln, Oscar Diedrich von.

VON HEINDENSTAM. See Heindenstam, A. V. Hugo von.

VON KARMAN, THEODOR. See Rouse, H., 1.

WADDELL, CHARLES E.

1. Statement. In U. S. Cong. House. Com. on Agr. . . . Hearings on the estimates of appropriations for the fiscal year ending June 30, 1909, pp. 754-756. Washington, 1908.

Presents the testimony of Mr. Waddell of North Carolina at a preliminary hearing on the proposed Appalachian and White Mountain Forest Preserves. Discusses results of examinations of streams of the southern Appalachians relative to varying flow conditions as factors governing hydroelectric installations. Results of an investigation on the effect of deforestation on stream flow are briefly described, noting conditions in a small pond in Asheville, N. C. Sediment brought down into the reservoir by Beaver Dam Creek from un-forested regions amounted to 12,000 cu. yd. in one year. Discusses the need of forests in water conservation, noting the effect of forests in maintaining the clarity of the water of Toxaway Lake (Savannah River).

WADDELL, HAKON.

1. Volume, shape, and roundness of rock particles. *Jour. Geol.*, vol. 40, no. 5, pp. 443-451, illus., July-Aug. 1932.

Deals with some fundamental principles, conceptions and ideas by which the numerical values of the various properties of sedimen-

tary particles may be utilized to determine the origin of a deposit and the factors involved in the changes of a sediment from one locality to another.

Discussion: CHESTER K. WENTWORTH, (*Jour. Geol.*, vol. 41, no. 3, pp. 306-309, Apr.-May 1933), in an article entitled *The Shapes of Rock Particles: A Discussion*, points out that certain statements and assumptions are susceptible to more than one interpretation; these statements are discussed. THE AUTHOR, (vol. 41, no. 3, pp. 310-331, Apr.-May 1933) in an article entitled *Sphericity and Roundness of Rock Particles*, considers Wentworth's criticism on shape determinations, degree of sphericity, and roundness. Discusses a practical method of determining the sphericity value of quartz particles. Modifications of shape and roundness of rock particles by non-chemical forces and by solution are considered.

2. Some new sedimentation formulas. *Physics*, vol. 5, no. 10, pp. 281-291, illus., 1934. Presents some methods of computing the sedimentation radius, and formulas for computing the resistance and radius of a sphere of a given terminal settling velocity. Determines statistically the amount of deviation of Stokes' law from experimental data of higher Reynolds' numbers.

3. The coefficient of resistance as a function of Reynolds' number for solids of various shapes. *Franklin Inst. Jour.*, vol. 217, no. 4, pp. 459-490, graphs, Apr. 1934.

Attempts to show the usefulness of the degree of true sphericity as an expression for the shape of rock particles. The paper is also intended to be a background for a new, analytical, sedimentographic method to be described in a forthcoming paper. Discusses the resistance of wholly submerged bodies in order to determine the coefficient of resistance as a function of Reynolds' number for solids of different degrees of sphericity. Introduces formulas for calculating the coefficient of resistance and Reynolds' number. Graphs show the influence of degree of circularity on the resistance.

4. Shape determinations of large sedimental rock-fragments. *Pan-Amer. Geol.*, vol. 61, no. 3, pp. 187-220, illus., Apr. 1934.

Describes some ways and means of approaching the problem of shape determination of large sedimental rock fragments with reference to sedimentological processes. Formulas for the coefficient of resistance and the Reynolds' number applied to experimental data are considered as essential factors which govern attempts to make sedimentological shape classifications of rock fragments. Introduces a practical formula for shape determinations of rock fragments and applies it to shape determinations of rock fragments from three different gravel deposits.

5. Volume, shape and roundness of quartz particles. *Jour. Geol.*, vol. 43, no. 3, pp. 250-280, illus., Apr.-May 1935.

Treats of methods of measuring the volume, shape, and roundness of quartz particles, and of attempts to obtain data on important properties of sedimentary rock fragments. Considers a classification of rock fragments in order to furnish a clue to the origin of the sediment and processes involved in transportation and deposition.

6. Volume, shape and shape position of rock fragments in openwork gravel. *Geog. Ann.*, vol. 18, no. 1, pp. 74-92, illus., 1936.

A study of openwork gravel in a typical osek and in the forset beds of glacial deltas. Considers the shape positions of rocks in the field which is determined by the angle of dip and the direction of the longest axis of each fragment with reference to the dip direction and the magnetic meridian of the bed of gravel. Describes the apparatus used in the laboratory for determining the shape position of rock fragments.

WADSWORTH, H. H. See Foote, A. D., 2; Harts, W. W., 2.

WAGGONER, W. W. See also Stevens, J. C., 2.

1. An early Yuba River flood. *Engin. News-Rec.*, vol. 107, no. 8, p. 305, Aug. 20, 1931.

Describes the record flood of 1861 in the Sacramento Valley, Calif. A lake equal to the size of Lake Michigan was formed in the Sacramento Valley by the flood. Yuba River flood debris covered farm lands and orchards to a depth of 9 ft. Note is made of silt deposited to a depth of 80 ft. in places as a result of hydraulic mining in the valley between 1870 and 1884, when it was stopped by injunction. Flood control by the use of debris-retaining reservoirs is advocated.

WAGNER, L. A. See Traxler, R. N., 1.

WAHLBERG, HAROLD E.

1. Survey reveals necessity for watershed protection as a conservative measure. *Hydraulic Engin.*, vol. 3, no. 12, pp. 26, 56-57, Dec. 1927.

Stresses the necessity of watershed protection by forestation as a soil and water conservation measure in southern California. Notes that the fire of Oct. 31, 1916 in the Harding and Santiago Canyons resulted, during rains of Nov. 26, 1916, in increased runoff containing such vast quantities of erosional debris and silt that it filled the entire Harding Dam to the top. The runoff showed a content of 40 percent silt and ash. A deposit of an inch of black sediment was spread over the flood plain of the Santa Ana River below the mouth of Santiago Creek.

WALKER, LESTER C. See Coldwell, A. E., 2.

WALKER, M. L.

1. Recent experience with bank protection works at Pine Bluff, Arkansas [letter to editor and editorial comment]. *Engin. News*, vol. 61, no. 4, p. 103, illus., Jan. 28, 1909.

Letter and editorial comment on experiences with bank protection works at Pine Bluff, Ark. Notes that the caving of banks and consequent destruction of property was not due to mattress protection but to needed repairs having been neglected.

WALKER, T. D.

1. (and Parson, A. L.). Changes in water level and floatation as forces of erosion. *Toronto Univ. Studies, Geol. Ser.*, no. 22, pp. 26-28, illus., 1926. Briefly describes results of observations on changes in water level and on the floatation of quantities of sand in a small creek at the north end of Munroe Bay near Port Coldwell, Lake Superior.

WALL, EDWARD E.

1. Water purification at St. Louis, Mo. *Amer. Soc. Civil Engin., Trans.*, vol. 60, pp. 170-195, illus., 1908.

Describes the water purification plant at St. Louis, Mo. Includes a table giving suspended- and dissolved-load determinations of Mississippi River water, Apr. 1906-Mar. 1907, at St. Louis and Bissell's Point, and the laboratory record at Chain of Rocks, Apr. 1-8, 1907. The effect of the purification plant on the reduction of suspended and dissolved load in the water supply is discussed.

2. River control at the new St. Louis water-works. *Engin. News-Rec.*, vol. 96, no. 14, pp. 570-572, illus., Apr. 8, 1926.

The control works on the Missouri River at Howard Bend, eight miles above St. Charles, Mo., were built to divert the river against the south shore in order to provide continuous deep water for the intake of the new St. Louis, Mo. municipal waterworks. Formation of sand bars in the river is discussed. Maximum turbidity of the Missouri River at Kansas City is noted as 16,000 p. p. m. and at Howard Bend, 12,000 p. p. m. The system of dikes and mattresses to control the river is described and their construction and mode of operation are given in detail. More than 300 acres of land have been added to the north shore by diverting the channel.

WALLACE, R. C.

1. (and Baker, W. F., and Ward, G.). The Red River as an erosive agent. *Roy. Soc. Canada, Proc. and Trans.*, vol. 20, sect. 4, pp. 149-167, illus., 1926.

Describes an investigation carried out to determine the nature of dissolved and suspended materials carried by the Red River, their seasonal variations, their relation to the composition of Lake Winnipeg into which the river flows and to such contrasted types as the Mississippi and St. Lawrence Rivers. The investigation was planned in connection with a study of lacustrine clays of the Red River Valley from which the river derives much of its dissolved and suspended materials. Describes the drainage area and discusses the analysis of the waters of the Red River, its tributaries, and Lake Winnipeg, noting methods of sampling. Includes tables which give chemical analysis, total solids; and suspended matter in parts per million. Discusses analyses, noting the average salinity of 500 p. p. m. over the course of the river, Aug.-Oct., 1925. Describes experimental work on leaching of surface materials in the Red River basin, giving analyses. Discusses total erosion and sedimentation in the basin, noting that the estimated total load past Winnipeg is 3,543,000,000 lb. of soluble matter and 777,000,000 lb. of suspended matter. At this rate the surface of the drainage area would be lowered 1 ft. in 80,170 yr. Gives comparison of suspended matter in the Red River and in Lake Winnipeg. Describes experiments of centrifuging Red River water to determine the state of silica contained in the water. Compares chemical analyses of waters of the St. Lawrence River at Ogdensburg, N. Y., the Red River at Winnipeg, Manitoba, the Illinois River near La Salle, Ill., the Iowa River at Iowa City, Iowa, and the Mississippi River at Memphis, Tenn.

WALLACE, ROBERT

1. Egyptian agriculture. *Soc. Arts, Jour.*, vol. 40, no. 2058, pp. 596-604, Apr. 29, 1892.

Describes the topography, meteorology, irrigation, fertilizing methods, river training, and agriculture in Egypt. Discusses basin irrigation by the muddy red water of the Nile which results in warped fertilized land. Notes the use of embankments for flood control. Describes the tendency of the Rosetta branch of the Nile to scour its bed and the Damietta branch to silt and aggrade. The use of spurs to protect river banks is mentioned.

Discussion: J. A. VOELCKER, pp. 604-605, notes that the value of Nile silt as fertilizer is greater than that of the manure used in England. J. HUGHES, pp. 605-606, notes the great value of Nile silt as fertilizer and refers to a chemical analysis he made.

WALSH, ORVILLE E.

1. Taming the Missouri River. *Assoc. Chinese and Amer. Engin. Jour.*, vol. 18, no. 1, pp. 59-68, illus., Jan./Feb. 1937.

Describes standardized stabilization structures now employed on the project for the improvement of the Missouri River for navigation. Notes that the average sediment content of the stream at Kansas City is about 5,000 p. p. m. and as great as 25,000 p. p. m. at other points. Heavy silt deposits are useful as prompt filling behind dikes.

WALTER, R. F. See Rothery, S. L., 4; Taylor, T. U., 6.

WARD, EBENEZER THOMAS.

1. The navigability of the lower Danube. *Inst. Civ. Engin., Minutes of Proc.*, vol. 230, pp. 280-312, illus., 1931.

Describes works executed in the Sulina Branch, 1891-1928. Includes data which give sediment-load data, 1894-1923. Treats of dredging at Sulina Mouth. Notes changes in the configuration of the coast line of the delta.

WARD, FREEMAN.

1. Notes on mud cracks. *Amer. Jour. Sci.*, vol. 6, no. 33, pp. 308-309, illus., Sept. 1923.

Refers to experiments and observations on mud cracks (Kindle, E. M., 2) and gives an observation relative to the effect of soluble salts and character of surface upon which mud is deposited on the shape of dried fragments. Cites observations of mud cracks in silt deposited on the Missouri River flood plain in South Dakota.

WARD, G. See Wallace, R. C., 1.

WARD, HENRY BALDWIN. See also Anonymous, 158.

1. Placer mining on the Rogue River, Oregon, in its relation to the fish and fishing on that stream. Oreg. Dept. Geol. and Min. Indus., Bul. 10, 31 pp., illus., tables, 1938.

Reports on investigations, for the Oregon Department of Geology and Mineral Industries, on the effects of placer mining operations on runs of fish in the Rogue River, Oreg. Describes the Rogue River, noting the effect of placer mining operations on the color of the water, also noting previous analyses made of Rogue River water during September 1911-August 1912 (Van Winkle, W., 2) representing conditions in the stream above placer mining operations and showing that suspended matter due to natural erosion varied from 3.6 to 1,360 tons per day and dissolved matter from 239 to 2,328 tons per day. Describes fish and fishing in the river and the muddy waters of the river, noting that the river always carries loads of silt due to erosion. Discusses changes in the river affecting fish life, such as dams, diversion ditches, and agricultural and industrial developments. Describes surveys of the Rogue River system at high and low water, noting the character of deposit, food supply, and general conditions for fish life. Discusses effects of placer mining and erosion silt on the welfare of the fish and notes that silt is not responsible for the killing of fish since it adds no toxic substance to water and introduces no organic materials which absorb oxygen and cause the fish to suffocate. Gives measurements on the turbidity of Rogue River water (tables). Discusses the effect of erosion silt on spawning grounds, and the quantity of fish food present in muddy waters, noting that particles of the silt collect organic particles and build a culture medium for the aquatic bacteria thus increasing the food supply of aquatic life.

2. Placer mining and the anadromous fish of the Rogue River. Science (n. s.), vol. 88, no. 2289, pp. 441, Nov. 11, 1938.

Presents results of the author's investigation for the Oregon State Department of Geology and Mineral Resources of the effect on salmon of silt derived from placer mining operations in the Rogue River watershed in Oregon. States that silt is not guilty of killing fish since it adds no toxic substance to the water and introduces no organic materials which absorb oxygen and thereby suffocate fish. It may even serve to protect fish by preventing them from seeing and being attracted by fishermen's lures. Laboratory tests at Reed College showed fingerling salmon and trout got on just as well in tanks of muddy water as the control groups in clear water.

WARD, HENRY T. See Kammermeyer, K., 1.

WARD, THOMAS R. J. See Griffith, W. M., 1.

WARE, L. A.

1. An electronic method for determining distribution curves. Electronics, vol. 13, no. 10, pp. 36-37, Oct. 1940.

Describes a circuit diagram of an apparatus for determining the distribution curve of any varying quantity which can be translated into a rotating motion and which can be used to measure turbulent flow. The circuit was developed for use in connection with an hydraulic flowmeter.

WARMKESSEL, CARL A.

1. Burden of Lehigh River during the flood of August 1933. Pa. Acad. Sci., Proc., vol. 8, pp. 94-96, 1934.

Discusses the sediment load of the Lehigh River during the flood of August 1933. Presents tabulated data on soluble, insoluble, and total burden during the week of Aug. 21-27, 1933, and on mechanical characteristics and mineral analyses of sediments. Samples were taken at the Hamilton St. Dam in Allentown and West Bethlehem, Pa.

WARNOCK, JACOB E.

1. Experiments aid in design at Grand Coulee. Civ. Engin., vol. 6, no. 11, pp. 737-741, illus., Nov. 1936.

Shows how model testing indicated a method of protection against scour at the toe of the overflow spillway and gave information on transverse wave and pool action, and river bed erosion. Includes design of spillway training walls, crest, and drum gate.

WARREN, C. H.

1. Determination of silt in flood waters of the Great Fish River. So. African Irrig. Dept. Mag., vol. 1, no. 2, pp. 40-42, Jan. 1922.

Presents results of silt determinations in the flood waters of the Great Fish River, Union of South Africa, 1919-21. Methods of sampling and of determining the percentage of silt are briefly described. The volume-weight relationship of deposited silt is given.

2. Halesowen irrigation scheme. So. African Irrig. Dept. Mag., vol. 1, no. 3, pp. 119-121, illus., Apr. 1922.

Describes the Halesowen "Flood" Irrigation Scheme on the Great Fish River six miles south of Cradock begun in 1875 and now a successful development. Details of silt control works near the intake of the scheme are described (p. 119).

WARREN, GEORGE M.

1. Tidal marshes and their reclamation. U. S. Off. Expt. Stas., Bul. 240, 99 pp., illus., 1911.

Describes results of investigations on the reclamation of tidal marshes. The types of marshes are described, noting in particular the type which is built up by the accumulation of detritus brought down by rivers and deposited with the instrumentality of tides. Considers the character and fertility of marshland soil deposited by the tide on the west side of the Delaware River, Delaware City, Del.; the beneficial effect upon crops of deposits of new soil on marshlands on St. Georges Creek, Newcastle County, Del.; and the character, fertility, and compactibility of marshlands on the east side of the Maurice River near Dorchester and Mauricetown, N. J. Includes results of supplemental investigations at Green Harbor and Wellfleet, Mass., and on the marshlands of Nova Scotia and New Brunswick.

WASHBURN, ALLEN E.

1. An open mouth for the Mississippi River. La. Engin. Soc., Proc., vol. 6, no. 1, pp. 17-41, Feb. 1920.

Reviews the 200-yr. effort to maintain a navigable entrance to the Mississippi River. Presents brief data on the rate of seaward advance of the bar in South Pass, sand waves, and shoaling in passes.

WASHINGTON, W. DE H. See also Grunsky, C. E., 1.

1. The Colorado River closure. Sci. Amer., vol. 96, no. 18, pp. 374-377, illus., May 4, 1907.

Describes the various attempts to close the breaks of the Colorado River into the Salton Sea. Discusses stream characteristics, conditions of erosion, and the transportation and deposition of sediment. Successful closure by Col. Randolph and H. T. Cory is described.

WATERS, W. F.

1. Suggestions as to relieving the Mississippi levees [letter to editor]. Engin. News, vol. 37, no. 18, p. 284, May 6, 1897.

Criticizes the levee system and notes the need for artificial cut-offs. Notes that there is no reason why the levee system should raise the river bottom by silt deposits except at bends. In a straight channel, confining the river to its banks should deepen the channel and increase the current.

WATERWAYS EXPERIMENT STATION. See U. S.

Waterways Experiment Station.

WATSON, E. B.

1. Clay boulders and the rolling action of water. Soil Sci., vol. 3, no. 6, pp. 513-514, June 1917.

Describes the effect of the rains of December 1916 in Ventura County, Calif. The outwash from terraces on the upper part of the Hueneme fan spread over the fan covering several square miles with a deposit of gravel, sand, silt and clay. Clay boulders were transported by rolling a considerable distance from their source. Conditions of sediment deposi-

tion on the flood plain of the Merced River, near Snelling, Calif., are briefly noted.

WATSON, JOHN WILBUR.

1. Abstraction of potassium during sedimentation. Thesis (Ph.D.) - University of Virginia, 30 pp., illus. 1913.

A paper which attempts to determine whether the absorption of potassium during sedimentation is chemical or physical in nature, if the abstraction of potassium differs in kind or degree from other bases, and if potassium is absorbed as flocculation takes place. Evidence indicates that potassium is abstracted as flocculation takes place. The absorption of potash from solution is mainly a physical phenomenon known as adsorption.

WATT, D. C. See also Thomas, B. F., 1.

1. Notes on the improvement of river and harbor outlets in the United States. Amer. Soc. Civ. Engin. Trans., vol. 55, pp. 288-305, illus., Dec. 1905. Presents various notes on river and harbor outlet improvements in the United States. Improvement by jetties, location, curvature, and limitations are discussed. Presents a tentative theory of laws for sinuosities in delta passes, based on various observations relative to erosion, transportation, and deposition of sediment. Natural trends of delta formation need to be considered for proposed training works and dredging operations. Cites improvements of the St. Johns River, Fla., South Pass of the Mississippi, and Galveston Harbor, Tex., as examples of the tendency of water to follow its chosen path. Emphasizes the economic value of speed in jetty construction. Discussion: L. J. LE CONTE, pp. 306-308, comments on the use of jetties and dredging as applied simultaneously or exclusively for the maintenance of harbor passes. The economic aspect of the question is presented in brief. The discussion concerns itself chiefly with tidal harbors. WILLIAM W. HARTS, pp. 308-318, comments critically upon the principles of river and harbor improvement as expounded by Watt. Factors of stream erosion and sedimentation and littoral flow are considered. Cites examples of improvements to various harbors on the Atlantic and Pacific Coasts. Possibilities for dredging are examined, with particular reference to the Mississippi River passes. THE AUTHOR, pp. 318-321, reviews the principles of sedimentation and the effect of location and channel curvature on jetty construction. Indicates that artificial improvements must follow general trends of natural passes. Discusses the economic aspects of engineering works at the mouth of the St. Johns River, Cumberland Sound, and the South Pass of the Mississippi.

WATTS, L. F.

1. (and others). The management of range lands. 74th Cong. 2nd sess., S. Doc. 199, pp. 501-522, illus., tables, 1936. George Stewart, Charles A. Connaughton, L. J. Palmer, and M. W. Talbot, joint authors. Discusses features of a program for management of western lands. Treats such subjects as a program for domestic livestock production, range rehabilitation, pests, diseases, poisonous plant eradication, grazing, capacity, watershed protection, wildlife, recreation, erosion control, and forest ranges. Mentions terrace trenching, erosion-control dams, debris dams, and water spreading by diversion as a means of artificial erosion control.

WEAVER, C. E. See Blaess, A. F., 1.

WEAVER, HARRY F.

1. A device for sampling material carried by silt-bearing streams. U. S. Bur. Mines Inform. Cir. 7249, pp. 1-2, illus., Aug. 1943. Describes a device for obtaining accurate samples of material from silt-bearing streams. Gives construction details and procedure of operation. Believes the device to be the best ever devised for sampling silt-laden streams.

WEAVER, WARREN. See also Mason, M., 2.

1. The duration of the transient state in the settling of

small particles. Phys. Rev., vol. 27, pp. 499-503, illus., Apr. 1925.

- * Discusses the time necessary to establish a steady state of distribution for the settling of small particles in a fluid.

WEBER, F. W. See Berger, L. G. den, 1.

WEBER, M., JR.

1. (and Moran, Raymond F.). A precise method for sieving analyses. Indus. and Engin. Chem., Analyt. Ed., vol. 10, no. 4, pp. 180-184, illus., Apr. 15, 1938.

Describes a precise method for the determination of the particle-size distribution of finely divided materials by means of sieving tests. Describes a method for the microscopic calibration of sieves.

WEBSTER, A. G.

1. On the angle of repose for wet sand. Natl. Acad. Sci., Proc., vol. 5, no. 7, pp. 263-265, illus., July 1919.

Presents results of experiments in determining the angle of repose of wet sand. Includes a table giving angles of repose for sand with varying amounts of water.

WEBSTER, JOHN J.

1. Dredging operations and appliances [abstract]. Engineering, vol. 43, p. 212, Mar. 4, 1887.

Discusses the objects of dredging, stating that wherever possible natural scour should be utilized. Notes improvements to the Clyde and Tyne Rivers by dredging and a plan for removing silt from the Alexandra Dock at Hull.

WEEKS, A. W.

1. Stream terraces in Texas and their relation to the formations of the Gulf Coastal Plain [abstract]. Geol. Soc. Amer., Bul., vol. 51, no. 12, pt. 2, p. 1952, Dec. 1940.

Points out that the article maps and describes stream terraces in the vicinity of the Colorado River from Austin, Tex., southeastward toward the Gulf of Mexico. States that the report pictures and describes the growth of the present Colorado River Delta, which is 4 miles in 8 years.

WEEKS, M. E. See Trough, E., 1.

WEGMANN, EDWARD.

1. Masonry dams. Amer. Soc. Engin. Contractors, Jour., vol. 4, pt. 1, pp. 5-34, illus., 1912.

Discusses the history and theoretical and practical aspects of the construction of masonry dams. Notes that early builders of masonry dams in Spain utilized scouring galleries for cleaning sediment from reservoirs. The operation of scouring galleries in the Alicante Dam is briefly described.

WEINIG, A. J. See Campbell, F. B., 1.

WEISS, A. See Fortier, S., 2.

WELCH, ASHBEL.

1. Address at the annual convention of American Society of Civil Engineers, Washington, D. C., May 16, 1882. Amer. Soc. Civ. Engin., Trans., vol. 11, pp. 153-180, May 1882.

Reviews various engineering achievements. Includes discussion on the projects for the improvement of the Mississippi River. The principles involved in sediment transportation and deposition by the stream are considered.

WELLONS, C. M.

1. Why beartraps fill with gravel. Engin. and Contract., vol. 66, no. 8, p. 368, illus., Aug. 1927. Discusses the cause of persistent deposits of gravel in old bear traps prior to the designing of a new bear trap for Lock No. 6, Ohio River. The proposed remedies to reduce deposits are described.

WELLS, R. C.

1. Flocculation of colloids. Natl. Res. Council, Div. Geol. and Geog., Com. on Sedimentation, Rpt., pp. 50-52, 1923.

Summarizes a few of the more important features of flocculation. Notes factors affecting the flocculation of fine suspensions. Discusses briefly the behavior of colloids toward electrolytes, rate of flocculation, valence relations to flocculating powers of different electrolytes, mutual precipitation of colloids at varying temperatures, and the effect of adsorption and absorption upon flocculation.

- WELTY, P. A. See Taylor, T. U., 6.
- WENTWORTH, CHESTER K. See also Krumbein, W. C., 12; Tester, A. C., 3; Wadell, H., 1.
1. A laboratory and field study of cobble abrasion. *Jour. Geol.*, vol. 27, pp. 507-521, illus., 1919.
Presents results of an investigation and outlines future work planned with reference to a field and laboratory study of cobble abrasion in stream transit. Briefly outlines the principal phases of the problem and describes the apparatus used in the experimental study. Results obtained deal with several factors related to the rate of change in size and shape of a given cobble in stream transportation.
 2. A field study of the shapes of river pebbles. *U. S. Geol. Survey, Bul.* 730, pp. 103-114, illus., 1922; [abstract], *Geol. Soc. Amer., Bul.*, vol. 32, no. 1, pp. 89-90, Mar. 1921.
Considers a field study of the shapes of pebbles which was undertaken to determine the relation between the roundness of pebbles and the distance they have been transported by running water. Comments on field work done on the Russell Fork of the Big Sandy River in southwestern Virginia. Experimental work was done by the use of a tumbling barrel at the State University of Iowa. Various results obtained by the study are given.
 3. A method of measuring and plotting the shapes of pebbles. *U. S. Geol. Survey, Bul.* 730, pp. 91-102, illus., 1922; [abstract], *Geol. Soc. Amer., Bul.*, vol. 32, no. 1, p. 89, Mar. 1921.
Describes a method of measuring and plotting the shapes of pebbles which is useful for studying the effect of rock structure and the effect of different agents of transportation at different stages on the shape of pebbles. A study of the shapes of pebbles can also be useful in the interpretation of the history of ancient deposits.
 4. A scale of grade and class terms for clastic sediments. *Jour. Geol.*, vol. 30, no. 5, pp. 377-392, illus., July/Aug. 1922.
Proposes a classification for clastic sediments and presents a scheme of classification compiled in part from a specific study of the terms presented in the report and in part from the results of a general consideration of terms in the field of sedimentary rocks. The scheme of grade terms presented is a series of names for clastic fragments of different sizes, ranging from clay (less than 1/256 mm.) up to boulder size (more than 256 mm.). Gives a scheme of class terms for sediments.
 5. Methods of mechanical analysis of sediments. *Iowa Univ. Studies in Nat. Hist.*, vol. 11, no. 11, 52 pp., illus., Oct. 15, 1926.
Presents descriptions of various mechanical analyses of sediments. Treats of such methods as screening, elutriation, and counting. Considers such subjects as collection of samples, preparation of samples, errors, computing, and plotting.
 6. The accuracy of mechanical analysis. *Amer. Jour. Sci.*, ser. 5, vol. 13, no. 76, pp. 399-408, illus., May 1927.
Deals with mechanical analysis by sifting. Presents data, useful for students, for adopting a standard sifting time and for knowing the accuracy of results. Tests were made with a Tyler motor-driven sieve shaker.
 7. Studies of coarse sediments, 1923-1927. *Nat. Res. Council, Reprint and Cir. Ser.*, no. 85, pp. 23-35, 1928.
Discusses important contributions to the study of coarse sediments, 1923-27. Includes a bibliography of 146 articles pertaining to coarse sediments.
 8. Method of computing mechanical composition types of sediments. *Geol. Soc. Amer., Bul.*, vol. 40, no. 4, pp. 771-790, illus., Dec. 1929.
Describes and discusses a simple method of computation that is especially adapted to the solution of the problem of determining the mechanical composition of sediments.
 9. The mechanical composition of sediments in graphic form. *Iowa Univ., Studies in Nat. Hist.*, vol. 14, no. 3, 127 pp., illus., 1931.
Presents in graphic form a compilation of results of mechanical analyses of eolian, fluvial, marine, lacustrine, pyroclastic, and glacial sediments. Is a comprehensive guide for the interpretation of the origin of sediments for which the mechanical composition is distinctive.
 10. (and Ladd, H. S.). Pacific Island sediments. *Iowa Univ., Studies in Nat. Hist.*, vol. 13, no. 2, pp. 3-47, illus., Feb. 6, 1931.
Describes the sediments and discusses the sedimentary processes in the Pacific Islands. Includes a brief description of conditions of fluvial silt deposition in the Hawaiian Islands.
 11. Fundamental limits to the sizes of clastic grains. *Science, n.s.*, vol. 77, no. 2009, pp. 633-634, illus., June 30, 1933.
Points out that the gravel-sand-silt-clay scale represents certain genetic units based on several fundamental modes of aqueous transportation and on several modes of derivation from parent rocks. Notes that detrital materials found in natural deposits occur more abundantly in the individual coarseness ranges than in transitional ranges. Lists modes of transport, such as traction for gravel, inertia suspension for sand, viscous suspension for silt, and colloidal suspension for clay.
 12. (and Wilgus, W. L., and Koch, H. L.). A rotary type of sample splitter. *Jour. Sedimentary Petrology*, vol. 4, no. 3, pp. 127-138, illus., Dec. 1934.
Describes tests of a rotary splitting machine in a large and small form and discusses certain problems of sampling. Gives various conclusions.
 13. The terminology of coarse sediments (with notes by P. G. H. Boswell). *Nat. Res. Council, Bul.* 98, pp. 225-246, table, 1935.
Deals with the classification and terminology of the coarse sediments. Surveys existing usage of terms and suggests revisions for certain terms.
 14. An analysis of the shapes of glacial cobbles. *Jour. Sedimentary Petrology*, vol. 6, no. 2, pp. 85-96, illus., Aug. 1936.
A study of glacial cobble shapes which considers the comparative shapes and markings of cobbles modified by glaciers and ice jams in Arctic and sub-Arctic rivers. Presents a verbal schedule for the description of cobble shapes, the cobble shapes being compared to some geometrical form. Uses such terms as wedge-shaped, prismoidal, bipyramidal, and pyramidal.
 15. The method of moments. *Jour. Sedimentary Petrology*, vol. 6, no. 3, pp. 158-159, Dec. 1936.
Comments on an article entitled Application of Logarithmic Moments to Size Frequency Distribution of Sediments (Krumbein, W. C., 9). This paper gives a new method of moments in computing the constants of frequency distribution of particle sizes in sediments. States that Krumbein's and Wentworth's methods are the same except for the formula of skewness. Notes the identity of statistical equations and that step by step the procedures are the same. Comments on the application of statistical methods in the study of sorting of sediments.
- WERNER, DONOVAN.
1. A simple method of obtaining the size distribution of particles in soils and precipitates. *Faraday Soc. Trans.*, vol. 21, no. 62, pt. 1, pp. 381-394, illus., Dec. 1925.
Describes a method of obtaining size and size distribution of soils and precipitates developed in the researches on the reaction mechanism during the formation of precipitates under the supervision of Professor Sven Odén.
- WEST, CHARLES R.
1. The present status of flood control [letter to editor]. *Civ. Engin.*, vol. 1, no. 8, pp. 741-742, May 1931.
Comments on the article entitled Mississippi River - A National Flood Problem (Coleman, J. F., 1). Estimates in 1892 for a period of 10 yr. show the average amount of bank erosion on the Mississippi River to be 9 1/2 acres in area with a depth of 66 ft. per mile of river. Most of the material dumped in the river is deposited a short distance from the point of origin. The

amount of silt brought into the lower river by tributaries is approximately the same as that carried into the Gulf. Discusses bank stabilization, construction of levees, diversion of tributaries, feasibility of reservoirs, and reforestation and land clearance between river and levees as a means of controlling floods. The plan for higher and wider levees was adopted. Notes studies at the U. S. Waterways Experiment Station, Vicksburg, on caving banks, effect of cut-offs, silting, etc.

WEST, FRANCIS D.

1. (and Siddons, Joseph S.V.). Torresdale filter plant - Methods and results, 1907-1913. New England Water Works Assoc., Jour., vol. 27, no. 3, pp. 358-392, illus., Sept. 1913.

Describes the methods and results of operation of the Torresdale Filter Plant, Torresdale, Pa. Includes data on annual maximum, minimum, and average turbidity of Delaware River water, 1907-12, and on annual maximum, minimum, and average dissolved and suspended load of the stream, 1910-12.

WESTBROOKS, F. F. See Dole, R. B., 1.

WESTBY, H. O. See Coldwell, A. E., 2; Harrold, L. L., 4.

WESTERN, R. W. See Buckley, A. B., 1.

WESTON, ROBERT SPUR. See also Flinn, A. D., 1; Hazen, A., 2.

1. The water supply of New Orleans and its improvement. New England Water Works Assoc., Jour., vol. 17, no. 2, pp. 157-171, illus., June 1903. Presents results of investigations on the quality of the Mississippi River water as a source of supply for New Orleans and methods for its purification. Data are given on composition and character of the Mississippi River water at New Orleans; average amounts of dissolved and suspended matter in the stream, Dec. 10, 1900-Aug. 17, 1901.
2. Sediment test for water and other fluids. Engin. News, vol. 72, no. 21, pp. 1024-1025, illus., Nov. 19, 1914.

Describes the Wizard Sediment Tester used for determining the amount of visible sediment in milk. Notes the applicability to testing suspended algae, iron, silt, etc.

WEYER, ALBERT E.

1. Muddy streams threaten fish. Mo. Conserv., vol. 3, no. 2, p. 5, illus., Dec. 1940. Deals with the effects of silting in streams and lakes of Missouri upon aquatic plant and animal life. Conditions of erosion causing increased siltation are briefly considered. Effective means of preventing siltation are briefly described.

WEYL, LEON H. See Sampson, A. W., 1.

WEYMOUTH, F. E. See also Kelly, W., 1.

1. Conservation of the waters of the Colorado River from the standpoint of the reclamation service. Science, n.s., vol. 56, no. 1483, pp. 59-66, July 21, 1922.

Reports on the conservation of Colorado River waters for power and irrigation purposes and to effect the control of floods. Discusses action of the Colorado River in building its delta region and describes its instability. Notes that regulation works on the Colorado River should be installed in the upper basin and in its tributaries in order to intercept a major portion of the water free from sediment, for where the river leaves the canyon region the estimated average annual sediment load is 80,000 acre-feet. Discusses the feasibility of constructing a reservoir at Boulder Canyon, noting the provision for silt storage of 5,000,000 acre-feet out of a maximum capacity considered to be 31,400,000 acre-feet.

WHEATON, H. H.

1. Progressive silting of a river delta studied. Civ. Engin., vol. 3, no. 2, pp. 89-91, illus., Feb. 1933. Describes model studies of the mouth of the Rangoon River, Burma. One mouth of the Irrawaddy River now has a bar 7 miles wide across the river mouth. Sittang River, east of Rangoon, has built up salt marshes at its mouth. Tides from the Gulf of Martaban cause tidal waves 6 ft. high in the rivers. Rangoon

bar is formed of fine sand, averaging 0.01 in. in diameter. The largest model, 40x50 ft., was built on the British Isles. Describes construction details of the model; use of templates; allowance for scour; selection of proper sand; methods of reproducing tidal effects, surface waves and winds; and experiments to secure material to give the proper bank erosion rate on the model. Gives a schedule of studies, to be made with the model, of conditions from 1877 to 2000, with and without river-mouth improvements. Colored sand is used to trace deposited sediment to the source on the model. The model will be in operation in 1933.

WHEELER, W. W. See Ockerson, J. A., 4.

WHEELER, WILLIAM HENRY.

1. The conservancy of rivers - The eastern Midland district of England. Van Nostrand's Engin. Mag., vol. 27, no. 166, pp. 281-296, Oct. 1882.

Describes various proposed works for the prevention of floods in the eastern Midland District, England. Includes a brief discussion on conditions of stream erosion and silting in the District.

2. Tidal estuaries and the bar of the Mersey. Engin. News [London], pp. 383-384, Nov. 11, 1887.

Discusses an article entitled The Bar of the Mersey by Mr. Shelford and The Movement of Sand in Estuaries by Prof. Osborne Reynolds. The writer makes comments on Mr. Shelford's paper noting that the paper was mainly historical in nature and gave a description of the bar. Notes that Mr. Reynolds, in his report on the movement of sand in estuaries, concludes that the lowering or raising of the sandy bed of an estuary depends solely on the character of water motion. Comments on Mr. Reynold's work with a model of the upper estuary of the Mersey. Treats of proposals to improve navigation of the lower Mersey. Deals with the formation and continuance of the bar at the mouth of the Mersey.

3. The application of the transporting power of water to the deepening and improvement of rivers [abstract]. Engineering, vol. 48, p. 482, Oct. 25, 1889.

Describes and discusses several mechanical means for utilizing the transporting power of water to remove shoals from river beds by mixing the material with the water and allowing it to be carried away in suspension.

4. Bars in tidal estuaries [abstract]. Engineering, vol. 49, p. 151, Feb. 7, 1890.

Summarizes theories of formation of bars in tidal estuaries. Forces maintaining the existence of bars originate from the sea. Removal of bars is accomplished by increasing the volume and velocity of tidal water passing over them, and by increasing the power of ebb current. Construction of piers from the shore is ineffective in removing bars unless the piers are carried to deep water.

WHIPPLE, GEORGE C.

1. Quality of Kennebec River water. U. S. Geol. Survey, Water-Supply Paper 198, pp. 167-211, illus., 1907.

Presents analytical data on the quality of the Kennebec River water, as well as that of some of the lakes and streams of its drainage basin. Analyses, conducted during 1903-04, on turbidity, color, and bacteria and dissolved solids-load of waters are given.

2. The principles of water purification. Cornell Civ. Engin., vol. 17, no. 9, pp. 269-277, June 1909. Discusses the principles and describes the processes of water purification. Includes a discussion on water purification by sedimentation, and gives brief data on settling velocities of particles of different diameters in still water.

WHIPPLE, WILLIAM, JR.

1. Missouri River slope and sediment. Amer. Soc. Civ. Engin., Trans., vol. 107, pp. 1178-1200, illus., 1942; also in Amer. Soc. Civ. Engin., Proc., vol. 67, no. 3, pp. 381-403, illus., Mar. 1941.

Presents a compilation of data from which prediction can be made of the ultimate effect the improvement of the Missouri River by open

- WHIPPLE, WILLIAM, JR. - Continued channel regulation has upon the hydraulic characteristics of the river. The study is concerned chiefly with the effect of improvement marks upon competence and capacity of the stream and the probable effect of these changes upon its eventual slope. Gives a description of the Missouri River and its tributaries. Treats of the nature of improvement; method; effects of improvement upon length, mean slope, width, shape, discharge, velocity, and roughness coefficient of the natural channel between Rulo, Nebr., and Sioux City, Iowa. Includes bed and suspended characteristics of the river in improved and unimproved sections; average mechanical analysis of bed and suspended sediment at Yankton and Omaha; relationship between discharge and total suspended load at Yankton (1939) and at Omaha (1930 and 1939); variation with discharge of the total volume of very fine sand and coarser materials in suspension in the river; and competence of the improved channel for the transportation of suspended sediment. Considers the applicability of bed-load formulas, involving competence and capacity, to the prediction of the future slope of the river.
- Discussion: SAMUEL SHULITS, pp. 1201-1203, comments upon Whipple's assumption of an average slope as a basis of the improvement of the Missouri River. Discusses Whipple's application to the Missouri River of bed-load formulas. LEO M. ODOM, pp. 1203-1205, notes that Whipple's discussion on the mechanics of bed-load and suspended-load movement seems vague. Criticizes Whipple's statement that the Straub formula was designed for uniform discharge only. E. W. LANE, pp. 1205-1211, notes the effects of the construction of contraction works on the Missouri River upon the slope and gradient of the stream; states that in the Missouri River the suspended load may be as potent as the bed load in the channel-forming process. Notes the possible effect of the Missouri River improvement upon channel conditions in the Mississippi River below the mouth of the Missouri. ELLIOT J. DENT, p. 1211, notes that the proposed improvements to the channel between Sioux City and Rulo to increase its bed-load-carrying capacity should be seriously considered since erosion at the upper end of the reach will probably occur and deposition will take place below Rulo. THE AUTHOR, pp. 1211-1214, comments on various points brought out by the discussers and clarifies various facts.
- WHITAKER, R.
1. Silt-sampling apparatus used on the Missouri River. *Engin. News-Rec.*, vol. 108, no. 11, p. 395, Mar. 17, 1932.
- Discusses the use of the Au type U. S. Geological Survey silt sampler, the Straub type sampler, a hand-operated orange-peel bucket, and the Lugn cylindrical bed-sediment sampler by the silt section of the U. S. Engineer Office at Kansas City, Mo. Each type is described. The Au type was discarded in favor of the Straub type sampler. The orange-peel bucket was discarded in favor of the Lugn type sampler.
- WHITCOMB, H. D.
1. The improvement of James River, Virginia. *Amer. Soc. Civ. Engin., Trans.*, vol. 28, pp. 209-236, illus., Apr. 1893.
- Describes dredging and contraction works on the James River, Va., for the improvement of the stream. Considers the effect of the works upon conditions of deposition and scour.
- WHITE, A. MCLAREN.
1. (and others). Studies in agitation-suspension of sand in water. *Indus. and Engin. Chem.*, vol. 24, no. 10, pp. 1160-1162, illus., Oct. 1932.
- S. D. Sumerford, E. O. Bryant, and B. E. Lukens, joint authors.
- Presents data on the mixing or suspending of an insoluble solid in a liquid by the use of a paddle agitator. Notes that in the case of an insoluble solid in a liquid, a maximum suspension is obtained after a very short period of agitation. Notes that uniformity of concentration is never obtained when the paddle is near the bottom of the tank. Points out that sand concentration does not indicate the stream flow of the liquid but is probably a practical measure of its velocity.
- WHITE, C. COSTLEY.
1. Some notes on afforestation of catchment areas. *Inst. Munic. and County Engin., Proc.*, vol. 61, no. 7, pp. 433-444, 1934.
- Presents the writer's opinion and arguments advanced by various authorities with regard to the beneficial or detrimental effects of afforestation of catchment areas. Includes a discussion on the effects of afforestation upon conditions of soil erosion and sediment transportation and deposition.
- WHITE, C. M.
1. Equilibrium of grains on the bed of a stream. *Roy. Soc. London, Proc., Ser. A, Math. and Phys. Sci.*, vol. 174, no. 958, pp. 322-338, Feb. 21, 1940.
- Discusses the conditions under which the movement of grains began on the bed of a stream; comments on their equilibrium on the stream bed. Gives equations concerning the equilibrium of grains as they are just about to move and notes the experiments dealing with the problem.
- WHITE, CURTIS G.
1. Queen of Barberton Navy soon to call it a season [news item]. *Plain Dealer (Cleveland, Ohio)*, Oct. 9, 1938.
- Describes the dredge Mayemba used to remove silt and rubbish from the Barberton Municipal Reservoir, Ohio. Accumulations reduced the capacity of the reservoir from 670,000,000 gal. to 550,000,000 gal. during 12 yr. of operation, 1926-38. The Mayemba pumps dredge material to the reservoir banks. Eventually the growth of pine trees will halt erosion of and block the vegetation on the banks.
- WHITE, D. E.
1. The sinking of land as a cause for the Mississippi floods [abstract]. *Science*, vol. 65, no. 1692, (sup.) pp. X-XI, June 3, 1927.
- A paper prepared for the meeting of the American Shore and Beach Preservation Association, suggesting, as one of the possible causes of disastrous floods, the slow sinking of the lower Mississippi Valley. States that the slow sinking, in the course of time, will cause slackening of river currents, will render it more difficult for the river to keep its lower trench clear from filling with sediment, and will carry the regions subject to flood lower down and nearer to sea level. These regions on the other hand, may be built up at the same time by flood contributions of sediments derived from high lands. Notes immediate importance of questions of silting up of river channels and effect of levees on scouring and silting of channel bed.
- WHITE, WILLIAM A.
1. Suggestions for the facilitation of grain count with the petrographic microscope. *Jour. Sedimentary Petrology*, vol. 10, no. 2, pp. 91-93, illus., Aug. 1940.
- Describes a new method for facilitation of grain count which consists of a new cross-hair arrangement and a spring-activated stage-lock to eliminate observations in the perispherical parts of the field of vision.
- WHITEFIELD, A. F.
1. Some practical experiments in silt control [abstract]. *Agr. Engin.*, vol. 9, no. 4, pp. 109-110, illus., Apr. 1928.
- Gives experiments conducted to increase soil fertility by flooding lands with silt-laden waters. Notes measures taken to reduce quantity and increase quality of sediment; also, results of experiments in increasing soil fertility by the use of silt.
- WHITFIELD, C. J. See Fleming, B. P., 1.
- WHITMAN, EZRA B.
1. The new Loch Raven Dam at Baltimore, Md. *Engin. News*, vol. 72, no. 6, pp. 331-337, illus., Aug. 13, 1914.

Describes the construction of the new Loch Raven Dam, Baltimore, Md. Notes that the annual deposit of silt in old Loch Raven Dam on Gunpowder River, completed in 1881, amounted to 226,000 cu. yd. The capacity was reduced from 510,000,000 gal. to 78,000,000 gal. by 1900 despite dredging. Dredging operations, 1900-1911, increased the capacity of the dam from 78,000,000 to 178,000,000 gal. The capacity of 400,000,000 gal. of Lake Roland on Jones Falls is largely reduced by silt deposits but dredging operations maintain its capacity at about 300,000,000 gal. Notes the method of by-passing muddy waters during periods of heavy rains and the use of alum to settle turbid waters in Lakes Montebello and Hampden.

WHITNEY, PETER.

1. The history of the county of Worcester, in the Commonwealth of Massachusetts. 339 pp. Worcester, Mass., Isaiah Thomas, 1793.
Notes that Nashaway, or Lancaster River, near Harvard, overflows its banks at certain seasons, and greatly fertilizes the bordering lands. Quaboag River, in Brookfield Township, overflows readily due to obstructions in the channel.

WHITTLES, C. L.

1. Methods for the disintegration of soil aggregates and the preparation of soil suspensions. *Jour. Agr. Sci.*, vol. 14, pt. 3, pp. 346-369, July 1924.
Describes an apparatus for the disintegration of soil aggregates. Gives a method for the comparison of the mechanical composition of soils. Notes that a combination of trituration and vibration gives a satisfactory degree of dispersion.

WICKHAM, L. L.

1. A theory of the flow of water over a canal weir [letter to editor]. *Engineering*, vol. 108, pp. 113-114, July 25, 1919.
Discusses a theory of the flow of water over a canal weir. Points out the applicability of a formula for calculating discharge over a simple weir in a still-water reservoir; the theory, however, does not prevail when applied to the canal weir. Describes a theory of action of water flow in a canal and over a weir, and the movement and deposition of sediment in the vicinity of the canal weir.
2. An investigation of the flow of water entering a canal from a river [letter to editor]. *Engineering*, vol. 108, p. 307, Sept. 5, 1919.
Notes the formation of a wedge of silt at the canal head, and the effect of flood flow on the deposit. Discusses conditions affecting the variation of flow, also silting and scouring in canals.
3. The general flow of water in open channels [letter to editor]. *Engineering*, vol. 108, p. 798, Dec. 12, 1919.
Concludes that the surface fall is necessitated by resistance due to turbulent motion and is determined by differences of level at head and end of channel; that sectional area of flowing water may be equal to or less than wetted sectional area; that depth of flowing water is equal to the sectional area of flowing water divided by width and is independent of the depth of the water; and that retardation is due to turbulent motion and projections into the stream. Notes that silt and scour are nature's methods of creating a channel suitable to natural flow and have no direct connection with velocity of the stream.

WICKLIFF, E. L.

1. (and Roach, Lee S.). Management of impounded waters in Ohio. *North Amer. Wildlife Conf.*, *Trans.*, vol. 2, pp. 428-437, 1937.
A discussion of the effects of various surface (stream and reservoir) waters in Ohio on the aquatic food, life, and natural propagation of the various species of fish found therein. Includes one paragraph, p. 428, on the extent and rate of silting in the O'Shaughnessy and Griggs Reservoirs.
2. Stream mistakes that should not be repeated. *Ohio Engin. Ext. Sta. News*, pp. 28-33, illus., Apr. 1944.
Comments on erosion control, stabilization of stream flows, control of stream-bank erosion, and pollution control. Gives photographs show-

ing before, during, and after effects of work projects on Ohio streams and illustrates projects that should not be duplicated.

WIEBE, A. H.

1. Limnological observations on Norris Reservoir with special reference to dissolved oxygen and temperatures. *North Amer. Wildlife Conf.*, *Trans.*, vol. 3, pp. 440-457, illus., 1938.
Presents the results of limnological observation on Norris Reservoir during the summer and fall of 1937. Points out that data show the dissolved oxygen, free carbon dioxide, and hydrogen-ion concentration to be different from that in natural and artificial lakes. Gives various conclusion as a result of the study.
2. Dissolved oxygen profiles at Norris Dam and in the Big Creek sector of Norris Reservoir (1937), with a note on the oxygen demand of the water (1938). *Ohio Jour. Sci.*, vol. 39, no. 1, pp. 27-36, illus., Jan. 1939.
Reports the vertical distribution of dissolved oxygen in the Big Creek sector of Norris Reservoir. The atypical distribution is due to high biological oxygen demand of the water at the head of the reservoir, causing stagnation within the hypolimnion, and to density currents carrying this stagnant water toward the dam at its characteristic temperature and density level.
3. Density currents in Norris Reservoir. *Ecology*, vol. 20, no. 3, pp. 446-450, illus., July 1939.
Presents results of measurements on the vertical distribution of dissolved oxygen, turbidity, and methyl orange alkalinity in Norris Reservoir, Tenn. Measurements bear evidence to the existence of density currents in the reservoirs.

WIEBEKING, CARL FREIDRICH VON.

1. Theoretisch-Practische Wasserbaukunst (Theoretical and practical hydraulics). *Rev. ed.*, 4 vols., Munich, 1811-17.
Considers various problems in the science of river development. Notes briefly the abrasion of river material and its influence on velocity of waters. Gives instructions on the execution of river construction works, and discusses silt and mud control in this connection. Treats rivers in northern Italy, lower Rhine, and Dutch River construction works. Deals with shore improvements, dam and dike construction, harbor construction, and canal construction, reclamation of swamps by sedimentation, reclamation by dredging, etc.

WIEGNER, GEORG.

1. Method of preparation of soil suspensions and degree of dispersion as measured by the Wiegner-Gessner apparatus. *Soil Sci.*, vol. 23, no. 5, pp. 377-390, May 1927.
Discusses the action of preparing a soil suspension by rubbing, shaking, and cooking. The apparatus of G. Wiegner and the photographic registering device of H. Gessner was used for a study of small changes in degree of dispersion.

WIGGIN, THOMAS H. See Freeman, J. R., 2.

WIGHTMAN, E. P. See Lambert, R. H., 1.

WILBY, F. B.

1. Control of floods in the alluvial valley of the lower Mississippi Valley--Arkansas River Reservoirs. 71st Cong., 3d sess., H. Doc. 798, vol. 2, pp. 1353-1466, illus., 1931.
Presents various data pertaining to the flood-control reservoirs on the Arkansas River. Includes a general discussion on the causes of siltage, means of prevention, and results of observations on the Arkansas River and other streams; considers causes of erosion, siltage in streams and reservoirs in the arid Southwest and in other streams, silt determinations in the Arkansas River system, effect of erosion and siltage on the Arkansas River channel, bedload, erosion-control measures, probable siltage from streams in the Arkansas River system, and the life of the proposed reservoirs in the Arkansas River basin.

WILGUS, W. L. See Wentworth, C. K., 12.

WILHELM, I.

1. La Durance et son utilization (The Durance and its

WILHELM, I. - Continued

utilization). Houille Blanche, vol. 9, pp. 31-38, 71-77, 115-117, illus., 1910.

Treats of the utilizations of the Durance River in France for irrigation and power. Gives a summary of dam problems in the Durance basin. Considers the project of the Greoulx Reservoir Barrage. Notes experiments on silting of the Qumson Barrage.

WILLCOCKS, SIR WILLIAM. See also Newell, F. H., 9.

1. Irrigation in lower Egypt. Inst. Civ. Engin., Minutes of Proc., vol. 88, pp. 300-330, illus., 1887; [abstract], Engineering, vol. 43, p. 180, Feb. 25, 1887.

Discusses the necessity of Nile River slime to enrich the soil and increase productivity. Notes the ineffectiveness of canal irrigation because of continual deposits which necessitate constant removal. Describes the basin method of irrigating lands with water containing mud of great fertilizing value, and river regulation works.

2. Irrigation in the Nile Valley and its future. Engin. News, vol. 46, no. 13, pp. 219-222, illus., Sept. 26, 1901; also in Engineering, vol. 72, pp. 336-338, illus., Sept. 6, 1901.

Describes the irrigation methods in the Nile Valley. Discusses basin and perennial irrigation systems noting, under the latter, that there are enormous deposits of silt in canals due to lack of adequate drains and escapes. Describes canal design to avoid siltation, means and costs of dredging canal deposits, river training, and continuation of existing banks by impeding Nile River mud and silt against stakes and brushwood.

3. A novel plan for diversion of an irrigation canal from a silt-carrying river [letter to editor]. Engin. News, vol. 63, no. 19, p. 573, May 12, 1910.

Discusses a novel plan for construction of the proposed Hilla branch diversion canal from the silt-carrying Euphrates River to lessen the likelihood of silting up of the canal.

4. (and Craig, J. I.). Egyptian irrigation. Ed. 3, 2 vols., illus. London, E. & F. N. Spon, Ltd., 1913.

Treats of the irrigation of Egypt, completely and scientifically. Acts as a guide to entering the Irrigation Service of Egypt and is of value to students of irrigation. Considers Nile bank protection, the problems of and prevention of silting in canals in Egypt, and the fertility of Nile silt.

5. The Assuan reservoir and Lake Moeris. 63d Cong., 2nd sess., H. Com. on Rivers and Harbors Doc. 17, 26 pp., 1914.

Describes details of the Assuan dam and reservoir, Egypt. Notes the value of sluices at the dam to keep the reservoir free of silt.

WILLEY, DAY ALLEN.

1. Protecting a railroad from flood currents. Sci. Amer., vol. 87, no. 22, pp. 361-362, illus., Nov. 29, 1902.

Describes revetment construction on the Missouri River bank near the town of Cambridge along the Chicago & Alton Railway. Fascine-matress and stone rip-rap provide permanent protection from erosion.

2. Irrigation in Southern California. Sci. Amer., vol. 91, no. 25, p. 439, Dec. 17, 1904.

Describes results of irrigation since 1900 of desert lands of Southern California. Notes briefly beneficial effects of sediment carried in irrigation canals supplied by the Colorado River.

3. Forest destruction and the erosion of arable lands. Sci. Amer., vol. 98, no. 21, pp. 372-373, illus., May 23, 1908.

Describes conditions of soil erosion due mainly to deforestation, particularly in the Piedmont region of the United States. Excessive floods, the transportation by streams of enormous amounts of sand, gravel, and detritus, bottom-land deposition, and other damages resulting from the accelerated erosion are considered. Briefly describes engineering work done in Europe to prevent the destruction of farm land. Notes the necessity of restoring the forests on the denuded watersheds of the streams.

4. The Yuma irrigation dam. Sci. Amer., vol. 99, no. 18, pp. 302-303, illus., Oct. 31, 1908.

Describes the engineering features of the Yuma irrigation dam. Notes extensive levee work to confine the channels of the Gila and Colorado Rivers, to prevent overflowing during floods, and to check the movement of sediment. Details of construction of the Laguna weir are given, noting its utility in excluding silt from irrigation canals by the application of the skimming process, also by creating a settling basin extending 10 miles above the weir. Notes the use of canal sections on each side of the stream as settling basins as a further precaution against canal siltage.

5. Sand waves and their work. Sci. Amer. Sup., vol. 65, no. 1677, pp. 120-121, illus., Feb. 22, 1928.

Describes conditions of sand-dune formation and movement and methods of checking sand movements along the Atlantic Coast and in the valley of the Columbia River in Oregon and Washington. The characteristics of the sand deposited by the Columbia River along its valley are briefly described.

WILLIAMS, A. M.

1. The effect of the immersion medium on the apparent radius of a particle. Faraday Soc., Trans., vol. 18, pp. 53-56, Oct. 1922.

Notes the necessity for allowing for an effect due to adsorption in calculating, by the use of Stokes' law, the radius of a particle immersed in a pure liquid. Shows how to obtain an upper limit to the thickness of the adsorption film upon a particle.

WILLIAMS, C. ADDAMS.

1. Note on the rivers of Bengal. Inst. Engin., Calcutta, Jour., vol. 5, pp. 109-120, Apr. 1925.

Considers such subjects as the composition of the delta, principal rivers, silt distribution and advance of the delta face, and the classification of the rivers of Bengal.

WILLIAMS, CYRUS JOHN RICHARD.

1. On some effects of land floods in a tidal river.

Inst. Civ. Engin., Minutes of Proc., vol. 145, pp. 334-339, illus., 1901.

Supplements a previous paper by the writer on some characteristics of floods in the Brisbane River, and notes the effects of these floods in the tidal compartment of the same stream. Notes (p. 335) the amount of alluvium deposited in the channel and over the outer slope of the bar by the flood of 1890.

WILLIAMS, E. J., JR. See Matthes, G. H., 6.

WILLIAMS, G. O.

1. Radium-bearing silts of southeastern Utah. Engin. and Mining Jour.-Press, vol. 119, no. 5, pp. 201-202, illus., Jan. 31, 1925.

Describes the occurrence of a low-grade deposit of radium of unique character in the silts forming the floor of the Montezuma Canyon in southeastern Utah. Discusses the geology of the canyon noting conditions of formation of the floor of the main canyon with silt beds 20, 40, and in places 60 ft. thick. Beds formed by the sudden floods heavily laden with silt cover evidences of the cliff dwellers which inhabited the region 800 yr. ago. Describes the sudden formation of washes, within the past 25 yr., in the silt beds. Leaching of uranium from sands and ore beds in the canyon and its redeposition in the silt beds of the canyon floor are described.

WILLIAMS, GARDNER S. See Freeman, J. R., 3.

WILLIAMS, GORDON R.

1. (and others). Selected bibliography on erosion and silt movement. U. S. Geol. Survey, Water-Supply Paper 797, 91 pp., 1937.

Covers works in foreign languages on soil erosion, river regulation, silt movement, and related subjects, including abstracts of various works. Gives brief vocabularies of French, German, and Russian terms. Arrangement is in chronological order and indexes facilitate the selection of material by subject, author, or periodical.

WILLIAMS, H. C.

1. Highway work and stream bank control experience. Pub. Works, vol. 71, no. 4, pp. 57-58, Apr. 1940.

Describes highway work and stream-bank control experience in Texas County, Okla. Describes the construction and the use of the modified Keltner type jetty to confine streams and to prevent bank erosion.

WILLIAMS, K. T. See Collins, W. D., 6.

WILLIAMS, LOU.

1. Classification and selected bibliography of the surface textures of sedimentary fragments. Natl. Res. Council, Div. Geol. and Geog., Com. on Sedimentation, Rpt., 1936-37, pp. 114-128, Oct. 1937. Considers the classification of the surface textures of sedimentary particles. Contains a bibliography of 134 items concerned with the problem of surface texture of sedimentary fragments.

WILLIAMS, RAMEY.

1. Stabilizing the Plum Point reach of the Mississippi River. Engin. News-Rec., vol. 101, no. 22, pp. 801-804, illus., Nov. 29, 1928.

Discusses the stabilization of the Mississippi River in the vicinity of Plum Point reach, citing the cost of the project during the past 47 yr. and the results achieved. An imaginary trip by boat through the reach in 1904 and again in 1927 is described noting control works visible, bars, shoals, channels, and channel depths existing each year. It was concluded in 1904 that bank stabilization had prevented river silting and raising of the river bottom elevation. By 1927 the stabilization works had disappeared, but in so doing had benefited navigation. These channel changes are cited to prove the undependability of the river stabilization methods.

WILLIAMSON, THOMAS.

1. Conservation by silt lining of ditches. Reclam. Era, vol. 29, no. 6, pp. 138-143, June 1939.

Describes the procedure and result of a demonstration of conservation by the silt lining of the distribution ditch on the Newlands project, Nev., 1938. Outlines a suggested program for a thorough examination and demonstration of the possibilities of the method, and for the development of principles and technique for its practical application.

WILLIAMSON, W. T. H. See Kermack, W. O., 1.

WILLIS, A. L. See Jackson, M. L., 1.

WILLIS, BAILEY.

1. Conditions of sedimentary deposition. Jour. Geol., vol. 1, no. 5, pp. 476-520, illus., July/Aug. 1893.

Discusses the various factors involved in and conditions of the mechanical, chemical, and organic deposition of sediments. Includes a discussion on mechanical deposition due to the current entering still water (lake deposits), alternating currents in fresh and salt water (estuarine deposits), the rise of the salt-water surface at a river's mouth in consequence of winds long continued from one direction (delta of the Mississippi), flotation of fresh water on salt water (bars of the Mississippi), flocculation of sediments in salt water, and the expansion and diffusion of a current in rapidly deepening water (silt deposits at edge) precipitation of lime and magnesia from ocean waters, charged by solution from land, by evaporation, by reaction of salt water on fresh water, and by varying atmospheric conditions on the surface of the sea.

WILLIS, E. A.

1. (and Robeson, F. A., and Johnson, C. M.). Graphical solution of the data furnished by the hydrometer method of analysis. Pub. Roads, vol. 12, no. 8, pp. 208-215, illus., Oct. 1931.

Presents a graphical solution for the data furnished by the hydrometer method of mechanical analysis. Describes a chart and mechanical device for obtaining from test data the hydrometer readings corresponding to specific grain sizes.

WILLS, A.

1. Vane-wheel eroder for Indian rivers [letter to editor]. Engineering, vol. 148, no. 3848, p. 421, Oct. 31, 1939.

Comments briefly on the letter (Chatley, H., 14) with reference to the effective operation of the jet-erosion process of maintaining small waterways.

WILM, H. G.

1. (and Cotton, John S., and Storey, H. C.). Measurement of debris-laden stream flow with critical-depth flumes. Amer. Soc. Civ. Engin., Trans., vol. 103, pp. 1237-1253, illus., 1938.

Describes experimental studies conducted in the San Dimas Experimental Forest, Calif., to test the effect of construction modifications on the rating of Parshall flumes in the San Dimas area, and to adapt gauging stations to give satisfactory measurements of small and intermediate debris-laden flows. Experiments with various critical-depth flumes are described. Results and conclusion are given.

Discussion: R. L. PARSHALL, pp. 1254-1257, considers the effectiveness of critical-depth measuring flume, newly developed at the San Dimas Experimental Forest, to gage flood flows carrying excessive quantities of bed load. Cites cases of successful application of the Parshall flume. Notes studies in Fort Collins Laboratory on the effect of sand and gravel passing through flume on indicated rate of discharge. MARTIN A. MASON, pp. 1257-1259, notes need for the reliable measurement of silt-laden flows of streams in Switzerland and the French Alps. Describes a successful technique, developed at the hydraulic laboratories of the School for Hydraulic Engineers and of Ateliers Neyret-Beylier and Piccard-Pictet (France), to measure flood flows containing a solid content as high as 40 to 50 percent by volume. EDWIN S. FULLER, pp. 1259-1264, describes studies on the stable natural "control" for gages on debris-laden streams. Notes conditions of debris deposition above rating flume and debris transportation through flume during model tests. Discussion includes data covering water surface heights in approach channels above rating flumes. HAROLD K. PALMER and FRED D. BOWLUS, pp. 1264-1266, note the effect of debris transportation on the use of critical-depth flumes. HARRY F. BLANEY, pp. 1266-1268, notes the successful application of Parshall measuring flumes in the valley areas of California, and cites problems in the application of flumes to measurements of intermittent debris-laden streams in the mountain canyons. The writer's experimental studies are described. THE AUTHOR, pp. 1271-1278, describes Parshall flume used for flow measurements of low gradient streams transporting fine material, and the San Dimas flume for measuring high-velocity streams transporting debris. Usability of flume depends on relation of normal flow velocities in flume and stream above, and concentration and size of transported material. Results obtained with Parshall and San Dimas flumes installed by U. S. Forest Service on San Dimas Experimental Forest are given. Model studies of San Dimas flume show inadequacy of small-scale models in studies of debris movement. Estimated contents of transported material in flows measured through San Dimas flumes are from 15 to 20 percent of solids.

WILSON. See Buck, Sir E. C., 1.

WILSON, A. N.

1. The stability of earthen channels I. Indian Engin., vol. 103, no. 5, p. 158, May 1938.

Cites misleading elements in the Lacey theory for design of stable channels in alluvium, noting the possibilities of the misinterpretation of statistics. Use of a "silt factor" in the Lacey theory and the "scatter" of the observed data when plotted are both noted.

2. The stability of earthen channels II, The effects of silt on regime dimensions. Indian Engin., vol. 103, no. 6, p. 203, June 1938.

Discusses the effects of silt upon the changes in the dimensions of regime channels.

3. The stability of earthen channels III, Experimental verification of silt effects. Indian Engin., vol. 104, no. 1, p. 29, July 1938.

Discusses effects of silt loading and grain size on channel regime, showing a correlation between observations of full-sized channels and of smaller models. Larger channels include

WILSON, A. N. - Continued

Lower Jhelum, Lower Chenab, and Upper Bari Doab Canals. It is concluded that: (1) Increase of quantity of silt of same grade increases slope and width of channel and decreases depth, also increases wetted perimeter; (2) increase of silt grade (size) has a very similar effect to increase of silt quantity.

4. The stability of earthen channels IV, Other factors controlling regime dimensions. Indian Engin., vol. 104, no. 2, p. 67, Aug. 1938.

Discusses the stability of channels, noting naturally and artificially stable channels and "berm resistance," which depends upon the water temper. e, the salt and clay content of the water, mixture of silt sizes, and type of berm vegetation. Erosion resistance of several different clays is noted and the experimental test procedure is described.

5. The stability of earthen channels V, Practical application of silt effects. Indian Engin., vol. 104, no. 3, pp. 93, 88, Sept. 1938.

Discusses the effects of the silt supply upon the regime dimensions of an irrigation channel. Considers the dependence of channel stability on the constancy of silt load. Briefly discusses silt control methods and subsequent adequate silt distribution in the irrigation systems.

WILSON, CHARLES B.

1. (and Clark, H. Walton). The mussel fauna of the Maumee River. U. S. Bur. Fisheries, Doc. no. 757, 72 pp., illus., Apr. 22, 1912. In U. S. Bur. Fisheries, Rpt. 1911.

Reports an investigation (1908) of the mussel fauna of the Maumee River. The character of bed of the stream is briefly described. Notes that a change in steadiness of flow of the river with the accompaniment of a more shifting bottom is due to forest removal at headwaters and has had considerable effect on the mussel life of the stream.

2. (and Clark, H. Walton). The mussels of the Cumberland River and its tributaries. U. S. Bur. Fisheries, Doc. 781, 63 pp., illus., Jan. 28, 1914. In U. S. Bur. Fisheries Rpt. 1912.

Presents results of an investigation (1912) to determine the distribution, relative abundance, and habits of the mussel species of the Cumberland River and its tributaries. Notes the effect of dams and consequent conditions of silting on mussel development above the dams. Gives data showing mineral conditions of the Cumberland River water at Nashville, Tenn., and Kittawa, Ky.

WILSON, CHARLES MORROW.

1. River come closer to my door! Sci. Monthly, vol. 52, no. 2, pp. 117-126, Feb. 1946.

Describes the use of sediment to build up fertile banana land along the Ulua River in Honduras by the United Fruit Co. Canals were constructed through levees to build up swampland. By the time World War II began, a total of 15,000 acres had been built up with deposits ranging from 6 in. to 10-12 ft. The expected goal is 90,000 to 100,000 acres. The approximate cost is \$100 per acre. The mean rate of building is 18 in. in 5 yr.

WILSON, GEORGE.

1. Irrigation in the South of France. Inst. Civ. Engin., Minutes of Proc., vol. 51, pp. 213-236, 1878.

Deals with the various aspects of irrigation in the South of France. Includes brief data on the quantity of sediment carried by the Durance, the chemical composition of matter held in solution and in suspension in the waters of the Durance and their agricultural value, the extent of silting in settling basins of canals taking water from the river, and the means of removing accumulated sediment from basins.

WILSON, HERBERT M. See also Davis, A. P., 9.

1. Irrigation in India. U. S. Geol. Survey, Ann. Rpt., 12, pt. 2, pp. 363-561, illus., 1891.

Reports on the various aspects of irrigation in India. Includes brief discussions on the amount and costs of silt removal from the Arrah irrigation canal of the Soane system, the factors involved in canal design in India to control scouring and silting, methods for silt control in irri-

gation canals and reservoirs, and methods of stream bank protection.

2. American irrigation engineering. Amer. Soc. Civ. Engin. Trans., vol. 25, pp. 161-218, illus., Aug. 1891.

Discusses the development of irrigation engineering in the United States. Includes two paragraphs describing the diversion weir of the Folsom Water Power Co. dam on the American River, Calif., noting the existence of three scouring sluices and wasteway which discharge silt-laden flood waters of the river under a head of 60 ft. and prevent excess silt deposits. Discussion: THE AUTHOR, p. 219, in answer to a query of Col. W. E. Merrill concerning irrigation with clear or muddy waters, states that the Indian practice is to use the clearest water possible whereas in the western United States, especially in case of the Turlock canals, the practice is to keep sediment in suspension in canals to allow its deposition on lands, which is considered desirable.

3. American irrigation engineering. U. S. Geol. Survey, Ann. Rpt. (1891-92) 13, pt. 3, pp. 101-349, illus., 1893.

Deals with the development of irrigation engineering in the United States. Includes a discussion on the silt problem in connection with irrigation works. Discusses in detail engineering devices which have been used to diminish the evil of silting in irrigation canals and reservoirs; considers briefly the value of silt as a fertilizing material.

4. Irrigation in India. U. S. Geol. Survey, Water-Supply Paper 87, 238 pp., illus., 1903.

Describes various irrigation works in India. The heavy silt deposits of the Indus River cause continual elevation of its bed and banks until the river changes its course. Irrigation, under this unstable condition, is best provided by inundation works. Construction cross-section, slope, alignment, and cost of canals are discussed. Causes of erosion, silting, and weed growth in canals are noted. Regulating sluices on various canals are described from the viewpoint of their effectiveness in preventing silt deposits at regulator heads. River training and improvement works for streams of India which would result in the least damage to irrigation works are considered.

WILSON, IRA T.

1. A new device for sampling lake sediments. Jour. Sedimentary Petrology, vol. 11, no. 2, pp. 73-79, illus., Aug. 1941.

Describes a sampling device which can be used to secure uncontaminated sediment samples from the beds of lakes of any depth of water or of sediment.

WILSON, JOSEPH D.

1. Observation on fluviatile deposits in Peoria Lake, Illinois. Chicago Acad. Sci., Bul., vol. 1, no. 2, pp. 13-21, illus., 1883.

Presents results of observations on the silting of Peoria Lake, Ill., 1867-77. Attributes the filling up of the bed of Peoria Lake to the work of Farm Creek. Data on distribution of silt in the lake, total silt accumulation, and rate of silting for the period are given. Describes the watershed of Farm Creek. Gives results of observations on bed- and suspended-load determinations of the stream and on bed-load movement. States that land 2 1/2 miles long by 1 mile broad has been made by Farm Creek in the 200 yr. since the French occupation.

WILSON, LEONARD S.

1. The geography of a part of the northwest Cumberland Plateau of Kentucky I, Physical geography. Mich. Acad. Sci., Arts, and Lett., Papers, vol. 23, pp. 391-402, illus., 1937.

Describes the physical geography of a triangular area with vertices at Monticello, Burnside, and Stearns in the northwest Cumberland Plateau, Ky. Notes fertility of the alluvial soils in valley bottoms which is maintained by stream deposits during flood. Rock or log dams are utilized to enlarge the available alluvial deposits by causing the deposition of transported material.

WILSON, WALTER T. See Lane, E. W., 21.
WILSON, WARREN E.

1. Pipe-line flow of solids in suspension, a symposium - mechanics of flow, with noncolloidal, inert solids. Amer. Soc. Civ. Engin., Trans., vol. 107, pp. 1576-1586, illus., 1942.

A study for the purpose of furnishing an elementary theory on the basis of which it is possible to interpret certain features of the available data of the transportation of solids in pipes. The theory represents an analysis of the flow using the basis of energy relationships. Notes that the theory explains several features of flow which were previously unsatisfactorily explained. Presents and analyzes experimental data from several sources on the basis of the background provided by the theory. States that the energy expended in maintaining the flow of a suspension of solids in a liquid may be noted as the sum of the energy needed to maintain the flow of a homogeneous liquid of the same density and the energy needed to keep the solids in suspension, through the fluid turbulence mechanism overcoming the tendency to settle.

Discussion: H. A. EINSTEIN, pp. 1589-1590, considers the difficulties encountered in measuring head losses in pipe lines carrying solids in suspension. Notes that Eq. 19 is not sufficiently explained. Points out that Mr. Wilson is correct in calling the criterion for settling of sediment on the bottom of the pipe a bed-load problem. H. E. BABBITT and P. H. CALDWELL, pp. 1590-1592, point out that information presented by them in 1939 and 1940 supplements that given by Mr. Wilson. This information is discussed in relation to Mr. Wilson's paper. THE AUTHOR, pp. 1592-1594, clarifies certain details brought out by the discussion and re-writes Eq. 19 in order to clarify the concept involved.

WINN, FRED.

1. The west fork of the Gila River. Science n.s., vol. 64, no. 1644, pp. 16-17, July 2, 1926.

Briefly describes observations on the changes in the channel of the west fork of the Gila River.

WINSLOW, E. EVELETH.

1. A resume of the operations in the first and second districts, Mississippi River improvement, 1882-1901. U. S. Engin. School, Occas. Papers, no. 41, 296 pp., illus., 1910.

Describes improvement operations by the U. S. Army Engineers in the Mississippi River within the limits of the First and Second Districts, 1882-1901, including contraction and bank revetment works and levee construction. Includes a description of the Mississippi River and its forces, eddies, transportation of drift, material carried in suspension, bottom-load transportation, bank caving, and bank and bar formation.

WINSOR, L. M.

1. Check dams control debris movements on mountain streams. Engin. News-Rec., vol. 107, no. 8, pp. 290-291, illus., Aug. 20, 1931.

Discusses the use of masonry check dams on streams in Utah, particularly noting the Willard Canyon spillway constructed by the U. S. Bureau of Public Roads, Division of Agricultural Engineering. The cost of the dam equals only half the cost of cleaning the gravel during the previous spring from canals and laterals of the irrigation system using the water. From 8 to 12 ft. of sediment has been deposited behind the check dam in 9 yr. The construction of the dam is described.

2. The barrier system for control of floods in mountain streams. U. S. Dept. Agr., Misc. Pub. 165, 24 pp., illus., Nov. 1933.

Discusses the use of the barrier system to control floods in mountain areas of the West. Describes conditions of debris transportation and deposition at mouths of canyons where streams leave mountains and enter broad valleys; flood characteristics of mountain streams; and the barrier control plan devised by the U. S. Bureau of Agricultural Engineering and details of designs. Describes examples of barrier systems in Utah and other locations. Compares effectiveness of the barrier method of flood control

with other methods. Notes requisites for success of the barrier systems.

3. Methods of flood control [abstract]. Science, vol. 88, no. 2273 (Sup.), p. 8, July 29, 1938.

A report to the American Society of Civil Engineers meeting in Salt Lake City, on methods of flood control. Notes value of upstream engineering practices for flood control in humid East, but states that it is a poor practice in arid West. Discusses system developed by Bureau of Agricultural Engineering for controlling floods in West by making torrential streams drop their deposits of silt where they will do the most good. Since the carrying power of a stream varies with the sixth power of its velocity, a stream slowed to one-half its velocity will drop 63/64ths of its load of mud and debris. Flood control, as used in many parts of the West, allows torrential creeks and tiny rivers to flow unchecked into valleys and to flatten areas, where a low barrier wall is set up around the area in which debris load is to be deposited. A decrease in velocity at these places induces the deposition of debris.

4. The barrier system of flood control. Civ. Engin., vol. 8, no. 10, pp. 675-678, illus., Oct. 1938. Discusses use and construction of "the barrier system," developed by the U. S. Bureau of Agricultural Engineering, in cooperation with agencies in Utah, for removing the heavy load of debris that flood streams carry. The system is based on the fact that the ability of the stream to carry sand, gravel, and boulders varies as the sixth power of velocity and that by spreading the stream to retard it to one-half its velocity, it will drop 63/64ths of its load. Describes the control works at Nephi, Utah, debris basins at Los Angeles, Calif., and the barriers at El Paso, Tex. Gives a detailed description of the barrier at Kessler Canyon near Garfield, Utah. Describes the proper method of constructing rubble-concrete masonry dams for barriers.

WINTERS, ERIC, JR.

1. (and Harland, M. B.). Preparation of soil samples for pipette analysis. Amer. Soc. Agron., Jour., vol. 22, no. 9, pp. 771-780, illus., Sept. 1930.

Describes a method of preparation of soil samples for pipette analysis. Considers dispersing agents and gives an outline of procedure for dispersion.

WISNER, GEORGE Y. See also Haupt, L. M., 1; Hooker, E. H., 1.

1. The Brazos River harbor improvement. Amer. Soc. Civ. Engin., Trans., vol. 25, pp. 519-537, Nov. 1891.

Discusses the improvement of the harbor at the mouth of the Brazos River, Tex. Most of the sand carried to the Gulf comes from banks caving on the lower 26 miles of the river. There is no delta formation at the mouth because of the fineness of sediment and the currents in the Gulf. A bar at the river mouth has been formed by sediment deposited during floods and by sand drifts. Discusses the effect of storms, action of waves and currents, and winds on bar formation; composition of the bar; the effect of sand drifts; and construction of a jetty, including cost, method, and effect on sand drift and silt deposits. Notes that 8,000,000-12,000,000 tons of sediment are deposited annually in the Gulf from the river.

Discussion: G. H. MENDELL, pp. 537-538, notes the condition existing at the mouth of the Brazos River where the waters of freshets, which are of short duration, carry 1/250 of their weight in sediment or an estimated annual total of 10,000,000 tons. Notes that if jetties prove permanent and other conditions are favorable, the 10,000,000 tons of silt annually brought down by the river will be sufficiently removed from the front of the jetties.

ARTHUR J. MASON, p. 540, notes the function of contraction works at harbor entrances to loosen and hold in suspension the solid matter, and that of the littoral currents to transport material out of the way. Cites visual observa-

tions at the mouth of the Brazos River. W. R. HUTTON, pp. 558-560, gives the opinion of Major Ernst (1887) on the impracticability of improvement by jetties. States that plans for improvement by jetties should consider the character of material transported, noting the character of material at mouth of the Mississippi and Brazos Rivers. Notes the necessity of extending jetties beyond bars into deep water.

2. Hydraulics of rivers having alluvial beds [abstract]. Engin. Rec., vol. 34, no. 14, p. 258, Sept. 5, 1896.

Discusses the rising bed between levees which maintain the natural slope of a river corresponding to the advance seaward of a delta. The average advance of the Mississippi River Delta is about four miles per century. Force expended by a stream in transporting sediment from headwaters to delta varies as specific weights of both water and sediment. Discusses the phenomenon of counter-currents at the mouth of the Mississippi River. Movement of sediment by floods is intermittent resulting from different characteristics of alluvial streams; constant discharge permits permanent improvements but, in fluctuating depths, scour and deposits may occur as in the St. Clair River, Mich. Cross-currents at river bends result in erosion of matter on concave and deposition on convex shores. The effect of bank slope on bank caving is shown in the Brazos River, Tex. Discusses the effect of velocity on the transporting power of a stream and notes that for any stated velocity, the amount of sediment that can be carried in suspension in a fixed volume of water increases with slope and decreases with depth.

WITZIG, BERARD J. See also Stevens, J. C., 6; Vanoni, V. A., 4.

1. Sedimentation in reservoirs. Amer. Soc. Civ. Engin., Trans., vol. 109, pp. 1047-1071, tables and graphs, 1944; also in Amer. Soc. Civ. Engin., Proc., vol. 69, no. 6, pp. 793-815, tables and graphs, June 1943.

Reviews the principal phases of the problem of reservoir sedimentation, including the origin and nature of sediment, its transportation to and through or deposition in the reservoir, and the remedies for reservoir silting. Defines silt, discusses rate of settling, and gives its specific weight. Presents information on the transportation of sediment, including suspended and bed load. Illustrates typical silt rating curves. Outlines the action of sediment in reservoirs, including delta and bottom deposits, and discusses the effect of reservoir shape and density flows on sedimentation. Includes information relative to estimating the rate of reservoir sedimentation by the use of regional indices and adjustment for trap efficiency. Outlines remedies for reservoir silting, including excavation, sluicing, erosion prevention, and desilting works.

Discussion: J. W. JOHNSON, pp. 1072-1075, discusses methods of estimating suspended load of streams by the use of silt-rating curves and the method of measuring the bed load as developed by Einstein. JOHN W. STANLEY, pp. 1075-1078, discusses definitions used by Witzig, and comments on rates of settling of particles. STAFFORD C. HAPP, pp. 1078-1079, comments on the relative importance of bank erosion and sheet erosion as sources of sediment in reservoirs. THOMAS H. MEANS, pp. 1079-1080, emphasizes need for studies and information on the quantity of sediment deposited above the reservoir level, and presents additional data on development of silt-rating curves. C. B. BROWN, pp. 1080-1086, discusses in detail the relationship of trap efficiency to reservoir storage capacity, the relation of rate of sedimentation to size of drainage area, and the relation of reservoir storage capacity to rate of storage loss. Presents a new formula for defining the trap efficiency coefficient of a reservoir and a formula for estimating the annual

rate of storage loss from known data. C. S. JARVIS, pp. 1086-1087, comments on the fertility of silt and effect of silt on seepage. H. S. BELL, pp. 1088-1089, discusses action of density currents, particularly in Lake Mead, as transporting agents of sedimentation. H. F. BLANEY, pp. 1089-1091, comments on the need for additional data on the relation of volume and weight of sediment and presents additional data on the specific weight of sediment. A. L. SONDEREGGER, pp. 1091-1093, comments on the effects of deforestation, overgrazing, cultivation, unstable slopes and road cuts, and other factors on sedimentation, and discusses methods of control. L. STANDISH HALL, pp. 1093-1098, notes that land slides, earth flow, and highway construction are additional sources of sediment. Discusses method of transportation of suspended sediment and bed load, and presents summary of sedimentation data on Chabot, Upper San Leandro, San Pablo, and Temescal Reservoirs near Oakland, Calif. Presents an equation expressing the relation between sediment deposits and size of reservoir, and discusses the use of debris barriers to control sedimentation. THE AUTHOR, pp. 1098-1106, recapitulates points brought up by the discussers and clarifies the erroneous and doubtful points with appropriate comments.

WOERMANN, J. W.

1. The Mississippi River. Assoc. Engin. Societies, Jour., vol. 55, no. 2, pp. 37-66, Sept. 1915.

Presents a description of the hydraulic features of the Mississippi River. Includes discussions on caving banks, sinuities, sediment transportation and deposition, bank revetment, contraction works, dredging and snagging, etc.

WOLFE, EMERSON.

1. Crops and dams protect a watershed. Agr. Engin., vol. 22, no. 2, pp. 62-64, illus., Feb. 1941.

Describes erosion and flood-control measures employed in the McGregor watershed bordering the Mississippi in northeastern Iowa. The purposes of the control work include the prevention of erosion and deposition on agricultural lands, and the prevention of silt and rock accumulations in the streets of McGregor and in the channel of the Mississippi River. Notes use of trash racks in stream channel above detention reservoirs to retain large rocks and debris.

WOLFE, PETER E. See Sharpe, C. F. S., 3.

WOLFF, H. H.

1. The design of a drift barrier across White River, near Auburn, Washington. Amer. Soc. Civ. Engin., Trans., vol. 80, pp. 2061-2076, illus., 1916.

Describes design and construction of a drift barrier across the White River, near Auburn, Wash. Includes 7 paragraphs giving a brief description of the White River, noting conditions of erosion and transportation of debris. Engineering features of control and rectification of the White River by dredging, bank protection, and construction of debris barrier are noted. The action of drift accumulations in a deviating river is described. Notes purpose of barrier design.

WOLFF, JOHN E.

1. Cloudburst on San Gabriel Peak, Los Angeles County, California. Geol. Soc. Amer. Bul., vol. 38, pp. 443-450, illus., Sept. 30, 1927; [abstract], Geol. Soc. Amer. Bul., vol. 39, p. 266, Mar. 30, 1928.

Describes cloudburst of April 4, 1926, on San Gabriel Peak, Los Angeles County, Calif. Conditions of erosion and deposition of detritus caused by the resultant flood in Rocky Gulch are described.

WOLMAN, ABEL. See Clyde, G. D., 1.

WONG, W. H.

1. Sediments of the North China Rivers and their geological significance; or a quantitative study of the phenomena of erosion and deposition in North China. Geol. Soc. China, Bul., vol. 10, pp. 247-271, 1931; [abstract], Civ. Engin., vol. 2, no. 6, p. 12, June 1932.

Presents results of a quantitative study on erosion and deposition in North China. The silt content of streams, rates of erosion on catchment areas, the chemical analysis of loess and

Huangho silt, and the grain size of sediments in streams are given. Flood plain aggradation, and advance of shorelines are noted.

WOOD, ALBERT E.

1. Multiple banding of sediments deposited during a single season. *Amer. Jour. Sci.*, vol. 245, no. 5, pp. 304-312, illus., May 1947.

Describes a study of sediments deposited in Arkport Flood Control Reservoir, Hornell, N. Y., during the spring of 1940. Inflow during a period of two weeks, when the reservoir was first put in operation, had three separate peaks resulting in banding of deposits similar to varves in general appearance. A comparison of grain-size curves of sediment in the reservoir with sediments of glacial origin in a glacial lake 120 miles east of Arkport shows a clear distinction between the two. Points out that several bands may be deposited in a very short time and therefore may not necessarily indicate age of deposits.

WOOD, B. A.

1. Stopping river bank erosion. *Engin. and Contract.*, vol. 65, no. 5, pp. 213-224, illus., May 19, 1926.

Describes construction of retards of whole trees securely anchored to Bignell reinforced concrete piles to prevent serious bank erosion on the Mississippi River, one mile north of Wickliffe, Ky. Notes that retards induced heavy silt deposits along the river bank.

WOOD, GORDON L.

1. Australian forests in relation to climate and erosion. *Austral. Forestry Jour.*, vol. 11, no. 4, pp. 131-138, illus., Dec. 1928.

Discusses the effects of deforestation in south-east Australia upon climate, the conservation of rainfall as shown in stream flow, erosion, and siltation. Conditions of silting in the Murray River and in the Hume Reservoir are briefly described. Notes that the annual net volume of silt deposited within the reservoir averaged 12,050,000 cu. ft. for an 8-yr. period.

WOOD, WALTER J. See Laverty, F. B., 1.

WOODBURN, RUSSELL. See also Borst, H. L., 1.

1. Erosion control in Kentucky by C. C. C. forces. *Engin. News-Rec.*, vol. 112, pp. 105-107, illus., Jan. 25, 1935.

Discusses the work of the U. S. Civilian Conservation Corps in western Kentucky on small soil-erosion projects. Describes an arrangement of check dams to prevent further gulleying and stop transportation of silt to lowlands and streams. Describes treatment of a typical case in the Tradewater River basin.

WOODFORD, A. O.

1. [Review of] *Die Geschiebe der Salzach*, by Eberhard Fugger and Karl Kastner. *Jour. Sedimentary Petrology*, vol. 3, no. 1, pp. 46-47, Apr. 1933.

Comments on a study (*Geschiebe des Donaubeckens*, 1, *Donau-Studien nach dem Plane und den Instructionen von Dr. Jos. Ritter v. Lorenz-Liburnau*, Dritte Abhandlung. *Geog. Gesell. Wien*, Mitt. vol. 38, Sup., 146 pp., 1895) of the sediments which gives complete and exact determination of the sources of materials. The study describes the collection of 26,000 pebbles from the bed of the Salzach. These were classified as to size and kind, and 20,000 were classified as to shape. Knowing the geology, the authors determined exactly the sources of the pebbles and the durability of various types. Concludes that pebbles are reduced in size more by cracking up into smaller pieces than by rubbing down of surfaces.

WOODS, A. F.

1. The control of raging waters. *Sci. Monthly*, vol. 44, pp. 409-417, illus., May 1937.

Deals in general with flood and erosion control, particularly considering the plan of M. W. Woods for river-bank erosion control which employs the use of the Bignell pile.

WOODS, F. W. See also Griffith, W. M., 1.

1. The problem of silt-control at the head works of the Sirhind Canal at Rupar. *Punjab Public Works Dept., Irrig. Branch Papers*, no. 21, 38 pp., illus., May 19, 1921.

Deals with methods of silt and water control adopted at the headworks of the Sirhind Canal at Rupar, India, and the specific effects of these measures. Cites the early history of the headworks. Discusses prevailing hydraulic conditions, silt difficulties in 1892-93, and the remedial measures undertaken to exclude excess of silt from canal. Discussion at the Simla Conference of 1904 evaluated the effects of the remedial measures. Criticizes past measures adopted for silt control and the present design of the headworks. Proposes an improved method of silt control at Rupar.

2. Irrigation enterprise in India. *Roy. Soc. Arts, Jour.*, vol. 70, no. 3641, pp. 705-736, illus., Sept. 1, 1922.

Discusses irrigation in India, noting in particular the Sukkur project. Discusses the effect of shoals, caused by deposits of sand in the Punjab Canals. Defective design of the lower Chenab Canal caused silting, which was remedied by a weir across the Chenab River at the head of the canal. Erosive power of the Ganges, Indus, Jumna and 5 rivers of the Punjab was due to steep gradients in the upper reaches. Describes the Sukkur project and gives in detail the design of the barrage to exclude sandy sediment from the canal. Discusses criticisms made of the Sukkur project and an alternative design to exclude silt.

3. A new hydraulic formula. *Engineer*, vol. 143, pp. 646-648, illus., June 17, 1927.

Presents a set of formulas in supersession or improvement of Kennedy's formula concerning the flow of silt-bearing streams of water in channels in alluvium.

4. Du Buat's experiments. *Engineer*, vol. 165, pp. 386-388, illus., Apr. 8, 1938.

A critical analysis of the experiments of Du Buat, 1786, relative to the erosive potential of a filament of water in a current.

WOODS, MARK W.

1. Stabilizing the banks of alluvial rivers. *Natl. Rivers and Harbors Cong., Proc.*, vol. 17, pp. 93-98, 1922.

Describes the design and effectiveness of the Bignell Pile in river improvement work and cites instances of successful use.

WOODWARD, A. E. See Richards, R. H., 1.

WOODWARD, C. M.

1. The basin and regimen of the Mississippi River. *Van Nostrand's Engin. Mag.*, vol. 27, no. 158, pp. 18-22, July 1882.

Presents a brief description of the basin of the Mississippi River and briefly discusses the hydraulic characteristics of the stream. Includes a discussion on the power of the river to transport sediment.

WOODWARD, SHERMAN M.

1. Headwaters control and use - the comprehensive engineering point of view. In *Upstream Engin. Conf., Headwaters control and use*, pp. 210-219, Washington, Govt. Print. Off., 1937.

Deals with some of the fundamental aspects of the water control problem and states briefly the requirements for the comprehensive point of view in connection with the problem. Discusses the effectiveness of small reservoirs on headwaters of river systems in the control of large amounts of downstream run-off and in the prevention of sheet erosion; presents briefly data to show that dams on small streams receive silt at a greater rate per square mile of watershed area than dams on large established areas.

Discussion: WALTER C. LOWDERMILK, pp. 219-220, comments on the role of vegetation on stream and flood flow. C. S. JARVIS, pp. 220-222, deals with small storage projects. R. U. BLASINGAME, p. 222, states the need of considering upstream engineering in any comprehensive conservation program and the need of cooperation between agencies.

WOOLLEY, A. F. See Ockerson, J. A., 4.

WOOLLEY, RALF R. See also Bailey R. W., 5.

1. The Green River and its utilization. *U. S. Geol. Survey, Water-Supply Paper* 618, 456 pp., illus., 1930.

WOOLLEY, RALF R. - Continued

Presents data pertaining to the available water supply of the Green River basin for purposes of planning its beneficial use. Notes briefly that silt observations conducted for a period of 24 days in April 1915 on the Green River at the Flaming Gorge reservoir site in Horseshoe Canyon indicates a silt content of 739.6 p. p. m. or less than 0.1 percent by weight. The contribution by headwater tributaries of silt and debris into the Green River is noted.

2. Floods in well forested regions [letter to editor].

Civ. Engin., vol. 3, no. 5, pp. 286-287, May 1933.

Comments on the article. Influence of Overgrazing on Erosion and Watersheds (Chapman, H. H., 3). Corrects quotations in statements on floods in Utah by Prof. Reed W. Bailey in hearings before the House Committee on Public Lands, 72nd Congress, 1st session on H. R. 11816, May 31, 1932. Erosion due to rainfall and topography rather than overgrazing. Serious floods also occur in Vermont where overgrazing is unreported. Floods near Pueblo, Colo. were greater before grazing than after. The Wasatch Plateau in Utah provides favorable conditions for cloudbursts, hence floods result.

WOOLMAN, ALBERT J.

1. A report upon ichthyological investigations in western Minnesota and eastern North Dakota. U. S. Comm. Fish and Fisheries, Rpt., (1893), pt. 19, pp. 343-373, illus., 1895.

Report on investigations (July-August 1892) to study the fish of Big Stone and Traverse Lakes, Minn., and to compare them with those of the Minnesota River and the Red River of the North. Describes briefly the character of bed and banks of the Minnesota River at Montevideo, Minn., and of the Red River of the North at Moorhead, Minn. Notes that the great amount of sediment in Red River waters appears to be detrimental to both animal and vegetable life.

WOOLSEY, T. S., JR.

1. Gila River flood control. Jour. Forestry, vol. 18, no. 3, pp. 293-294, Mar. 1920.

Reviews a report (Olmstead, F. H., 1) relative to the control of Gila River floods. Notes that stream improvements can be accomplished by: (1) Control of grazing in watershed, (2) use of check dams or small retarding works in the stream channel to lessen velocity, control amount of silt carried, and flatten out the flood peak of the stream, and (3) the operation of a system of floating gates to protect banks from undercutting. Points out that the general condition of the watershed ground surface is the nucleus around which the proposed runoff regulation work must be concentrated.

WORD, O. C., JR.

1. Hydrologic studies - Compilation of rainfall and runoff data from the watersheds of the Ark.-La.-East Texas Sandy Lands Conservation Experiment Station, Tyler, Texas, 1931-39. U. S. Soil Conserv. Serv., SCS-TP-41, 21 pp., illus., tables and graphs, June 1941.

Reports hydrologic investigations on small watersheds at the Soil Conservation Experiment Station, Tyler, Tex. Gives data on rainfall, runoff, watershed sizes, etc. The measurements of soil losses in runoff water were made by means of Ramser silt samplers and silt boxes.

WORK, LINCOLN T.

1. Methods of particle size determinations. Amer. Soc. Testing Mater., Proc., vol. 28, pt. 2, pp. 771-812, illus., 1928.

Discusses methods of determining the size of particles with respect to the principles of operation, technique, methods of representation, and limits of application. Classifies methods as indirect and direct.

2. Particle measurement problems. Chem. & Metall. Engin., vol. 45, no. 5, pp. 247-249, May 1938.

Describes various methods for measuring particle-size characteristics of materials. Factors to be considered in the selection of a

method are noted.

WORTHINGTON, ERASTUS.

1. The history of Dedham, from the beginning of its settlement, in September, 1635, to May, 1827. 146 pp. Boston, Dutton and Wentworth, printers, 1827.

States that trees are imbedded in the mud of the Charles River, Mass., 8 or 10 ft. and are as low as the present bed of the river.

WRATH, WILLIAM F.

1. Contamination and compaction of core sampling. Science, n. s., vol. 84, no. 2189, pp. 537-538, Dec. 11, 1936.

Presents results of experiments conducted at the Woods Hole Oceanographic Institution on the extent of contamination and compaction of sediment samples obtained by coring instruments.

WRIGHT, CHILTON A.

1. Experimental study of the scour of a sandy river bed by clear and by muddy water. U. S. Natl. Standards, Jour. Res., vol. 17, no. 2, pp. 193-206, illus., 1936; [abstract], Amer. Geophys. Union, Trans., vol. 17, pp. 439-440, July 1936.

Describes and presents results of experiments comparing conditions of scour produced by muddy and clear waters in a sloping flume with a bed of fine sand; attempts thus a simulation of conditions of scour in the lower Colorado River prior to and after the construction of Boulder Dam. Character and mechanical analysis of material used for the experiments and design of the flume used in the investigation are described. Depicts briefly the general procedure for most experiments, preliminary experiments to determine hydraulic properties of the flume prior to the addition of the sand bed, and final experiments to determine the conditions of scour. Results of the investigation are given, including determinations of roughness factor, critical velocities of water, types of sand movement, quantity of material scoured, the effect of suspended silt additions on the flow of a clear stream, and the velocity of distribution in the flume. States in conclusion that the clear water discharge at Boulder Dam will scour the sand bed to a greater extent than did muddy water prior to construction of the dam.

WRIGHT, FRANCIS H. See Sonderegger, A. L., 1.

WRIGHT, G. FREDERICK.

1. Origin and distribution of the loess in northern China and central Asia. Geol. Soc. Amer., Bul., vol. 13, pp. 127-138, illus., Mar. 30, 1902.

Presents results of observations on the fluvio-glacial origin and distribution of loess in northern China and central Asia. Notes the present activity of streams as erosive agents as evidenced by conditions of stream and valley aggradation, growth of river deltas, and advance of shore lines.

WRIGHT, H. T.

1. The flood problem in China. Engineer [London], vol. 133, pp. 600-602, illus., June 2, 1922.

Deals with the various aspects of flood control in China. Includes brief discussions on the characteristics of the alluvium of the great plain of North China, erosion, and sediment transportation and deposition.

WRIGHT, HAMILTON M.

1. Harnessing the Nile. Sci. Amer., vol. 149, pp. 258-260, illus., Dec. 1933.

Describes completed and proposed engineering works to regulate Egyptian streams in order to provide for perennial irrigation. Also describes the basin system of irrigation, and the extent of its present usage. Notes among other engineering problems involved that of reservoir silting.

WROTNOWSKI, A. F. See Ockerson, J. A., 1.

YEH, Y. N. See Hsieh, C. T., 1.

YELLOW RIVER COMMISSION.

1. Regulation of the lower Yellow River. Studies on Yellow River Proj., Pub. 9, 105 pp., illus., June 1947.

Discusses the problem of regulating the lower Yellow River, China. Comments on improvement of levees, river bed, and river mouth.

Notes flood-control works and comments briefly on bank protection. Considers various protective structures concerned with the silt problem.

YEN, CHEN-HSING. See also Bogardi, J., 1.

1. Flood control in China. Iowa Engin. Soc. Proc., vol. 52, pp. 129-130, 1940.

Presents a brief historical review of flood control in China. Some brief data are given on the hydraulic characteristics of the Yellow River.

YEO, HERBERT W. See also Black, R. F., 1.

1. Report on the Canadian River investigation, 1929. N. Mex. State Engin., Bien. Rpt. 9, pp. 175-216, illus., 1930.

Reports on progress during 1929 of an investigation relative to stream discharge and irrigation potentialities of the Canadian River in New Mexico. Notes that the stream carries about 2-2 1/2 percent of silt in suspension. Data on silt content of the stream and its tributaries indicate that the tributaries carry a larger percentage of silt than the main stream.

YONGE, SAMUEL H. See Fox, S. W., 1; Ockerson, J. A., 1.

YOUNG, C. H. See also Ramser, C. E., 4.

1. (and Harbaugh, Robert). Erosion problems on dredged channels as related to bank protection. Iowa Engin. Soc., Proc., vol. 42, pp. 61-66, 1930. Considers the erosion and silting problems of tributary streams to dredged channels and of larger rivers and channels along the Mississippi River from the northern to the southern limits of the State of Iowa. The relation of the erosion problem to problems of bank protection is discussed.

YOUNG, G. R.

1. Movement of solids in rivers. Internatl. Cong. Navigation, 15, Venice, 1931, Sect. 1, Question 2, pp. 15-20.

Summarizes aspects of lower Missouri River improvement. The movement of suspended material is considered and bed-sediment is also noted. Gives conclusions and makes recommendations. Comments on new gradients and alterations in the vertical and horizontal configuration of the bottom.

YOUNG, HENRY W.

1. Large model aids study of Bonneville project. Engin. News-Rec., vol. 115, pp. 195-196, illus.; Aug. 8, 1935.

Discusses the design and use of a 1:100 scale model of the five-mile stretch of the Columbia River from Tanner Creek to the head of Cascade Rapids, which will be the site of the Bonneville power project. The model is located at Linnton, Oreg., on the bank of the Willamette River., and the work is being done by the U. S. Engineer's Office. Model studies to determine cofferdam design, scour below spillways, silt deposition below dam, available river heads and design of fishways, and details of method of constructing and calibrating the model are given. Another model on a scale of 1:36 is used to determine scour below spillway and baffle design to overcome scour.

YOUNG, J. M.

1. River planning in the Missouri basin. Military Engin., vol. 22, no. 122, pp. 152-158, illus., Mar./Apr. 1930.

Discusses river surveys, gaging, and mapping by the U. S. Engineer Corps in the Missouri River basin resulting in over 500 maps and preliminary designs for 400 miles of canals and 25 dams. Most comprehensive silt study yet attempted includes systematic sampling of some 29 points in the basin resulting in 12,000 samples of bed and suspended silt. Extensive tests were made of silt samplers and silt sampling technique.

YOUNG, LEIGH J. See Clapp, E. H., 2.

YOUNG, SAMUEL MCCAIN.

1. The port development problem of the lower Mississippi. Amer. Soc. Civ. Engin. Trans., vol. 87, pp. 1025-1032, illus., 1924.

Notes the problems connected with the development of the Port of New Orleans on the lower Mississippi River. Discusses the surface geology of the lower Mississippi noting the alluvi-

al character of the soils and subsoils and gives the general theory of delta formation. Scour and shoaling problems in the New Orleans harbor are due to changes in regime of the river and the excessive amount of silt carried by the Mississippi River. Describes the instability of river banks within the limits of the port and the types of structures built.

YOUNG, WALKER R.

1. Report on salt water barrier. Calif. Dept. of Pub. Works, Div. Water Resources, Bul. 22, 667 pp., illus., 1929.

Presents results of an investigation conducted to determine the feasibility, probable effectiveness, and approximate cost of a salt-water barrier constructed at some point below the confluence of the Sacramento and San Joaquin Rivers, Calif., to prevent incursions of salt water into the region of the delta. Includes a discussion on the subject of silt in order to determine the effect of a salt-water barrier upon silting of the bays and upon the Golden Gate Bar. Considers the formation of the bays, changes in bays due to silting, changes in Golden Gate Bar, character of silt, silt carried in suspension, rate of settlement of silt, colloid silt, and probable effect of the salt-water barrier upon silting in the bays and upon the Golden Gate Bar.

2. Significance of Boulder Canyon project. Civ. Engin., vol. 5, no. 5, pp. 279-281, illus., May 1935.

Discusses briefly the silt-carrying proclivity of the Colorado River and the cause and effect of breached levees. Boulder Dam will reduce the cost of removing silt and increase the domestic water supply.

3. Mission of Boulder Dam fulfilled. Civ. Engin., vol. 5, no. 6, pp. 352-356, illus., June 1935.

Describes results obtained and to be expected by the construction of Boulder Dam. Four paragraphs on silt note the amount of silt carried by the Colorado River; the effect of deposition on irrigation works, laterals, canals, etc.; the silt retention capacity of Boulder Dam; the effect of future dam construction above Boulder Dam; and the expected rate of silting of Boulder Dam.

4. Boulder Dam plays its part in reclamation. Reclam. Era, vol. 27, no. 2, pp. 26-28, illus., Feb. 1937.

Presents the significance and results of the construction of Boulder Dam. Discusses the silt carrying proclivity of the Colorado River and the effect of breached levees. Boulder Dam will reduce the cost of removing silt and increase the domestic water supply. The amount of silt carried by the Colorado River and its effect on irrigation works, canals and laterals is discussed.

ZAMARIN, E. A.

1. Design of clearing basins. Moscow, Hydromeliorative Inst., Sci. Papers, M. G. M. I., 5, pp. 15-46, illus., 1938. In Russian. Translation on file in the U. S. Soil Conservation Service, Washington, D. C.

Comments on the existing methods for determining the length of clearing basins and gives a proposed method for determining their length. Gives various designs for clearing basins.

ZEASMAN, O. R. See Bates, C. G., 3.

ZELLER, N.

1. Tough lake dredging job. Pacific Builder and Engineer, vol. 52, no. 9, pp. 52-55, illus., Sept. 1946.

Discusses the dredging of Roslyn Lake, Oreg. The lake had been reduced by half, due to the deposition of 840,000 cu. yd. of silt and sand. A pipeline suction dredge was used.

ZIEGLER, VICTOR.

1. Factors influencing the rounding of sand grains. Jour. Geol., vol. 19, no. 7, pp. 645-654, illus., Oct./Nov. 1911.

Describes results of experimental work which emphasize the influence of viscosity in the rounding of sand grains.

ZIES, E. G. See Sharpe, C. F. S., 3.

ZILE, REUBEN R.

1. Plantings for control of river-bank erosion in Vermont. N. Y. Bot. Gard. Jour., vol. 42, no. 501, pp. 215-219, illus., Sept. 1941.

ZILE, REUBEN R. - Continued

Describes the use of vegetation in river-bank erosion control along the lower Winooski River in Vermont.

ZIMMERLY, S. R. See Gross, J., 1.

ZINGG, A. W.

1. Hydrologic studies. Compilation of rainfall and run-off from the watersheds of the Shelby Loam and Related Soils Conservation Experiment Station, Bethany, Missouri, 1933-1942. U. S. Soil Conserv. Serv., SCS-TP-39, 25 pp., illus., tables and graphs, Mar. 1941, and its Supps. 1-2, 1942-43. Consists of a compilation of hydrologic and land-use data on small watersheds at the Shelby Loam and Related Soils Conservation Experiment Station, Bethany, Mo. Soil loss in runoff from watersheds was determined by the use of silt boxes and the Ramser silt sampler.

ZON, RAPHAEL.

1. Final report of the National Waterways Commission, Appendix V. Forests and water in the light of scientific investigation. 62d Cong., 2d sess., S. Doc. 469, pp. 205-302, illus., 1912. Discusses the effects of forests upon water supply and stream flow. Notes importance of forests in preventing soil erosion and consequent interference with stream regimen by silt deposition. Notes effective control of streams by reforestation in France; effect of debris washed from hills into stream channels upon flood heights; and effect of denudation of mountain slopes upon stream flow and stream and valley sedimentation in the southern Appalachians.

ZWERNER, GENE A.

1. Reservoir silting data. U. S. Soil Conserv. Serv., Sedimentation Div., Tech. Let. Sed-9, 1 p., table, Feb. 24, 1939. Consists of table which gives a summary of data obtained from reservoir sedimentation surveys made by the Section of Sedimentation Studies, Division of Research, U. S. Soil Conservation Service, through June 30, 1938.
2. (and Johnson, J. W., and Flaxman, E. M.). Advance report on the sedimentation survey and suspended matter observations in Lake Issaqueena, Clemson, South Carolina, 1940-41. U. S. Soil Conserv. Serv. SCS-SS-37, 36 pp., illus., Nov. 1942. A sedimentation survey conducted by the U. S. Soil Conservation Service during the period Apr. 11-17, 1941, at Lake Issaqueena, a basin-type reservoir of 1,836-acre-foot capacity, located on Six Mile Creek, a tributary of the Keowee River six miles northwest of Clemson in northwestern South Carolina, revealed that a total of 88 acre-feet (141,970 cu. yd.) of sediment had accumulated in the reservoir at an average rate of 149.24 cu. ft. annually per acre of drainage area, entailing an annual storage loss of 1.65 percent, or a total of 4.79 percent to the date of survey. The reservoir sediment ranges in texture from gravel to clay. This survey was made specifically in connection with (1) a research investigation on the passage of sediment-laden density currents through the lake and their utilization to decrease the rate of silting, and (2) the planning of a conservation program on the drainage area. The results of the program demonstrate the desirability of wasting water of high sediment content such as usually exists in the lower part of the storage place, either by general settling of sediment, or by the occurrence of underflow through sluice gates.

ANONYMOUS.

1. Deepening the beds of navigable rivers. Polytech. Jour., vol. 2, pp. 132-133, 1839. An editorial describing the means of deepening the beds of navigable rivers by using harrows or rakes to agitate deposited material during an ebbing tide. Notes the successful use of a method on the River Mersey to obtain a navigable channel to the Port of Liverpool.
2. Bars at the mouths of rivers and harbours. Polytech. Jour., vol. 3, pp. 25-33, 1840.

Discusses the various factors which affect the deposition of silt and the formation of bars at the entrances of navigable streams. Conditions of sediment transportation and deposition in the streams of England are considered, noting that in 18 yr. mud deposits of no less than 10 ft. were found in reservoir at Islington. Methods for the prevention and removal of bars at the entrance of rivers are discussed.

3. Alluvial deposits in Fever River. Northwest. Gaz. and Galena Advertiser, vol. 7, no. 51, p. 2, Oct. 30, 1841.

Boats find difficulty in passing shoal places of the Fever River, Galena, Ill. Fear is expressed that the river is filling up with alluvial material. Emphasizes the necessity of procuring a dredge.

4. The fertilization of land by warping. Penny Mag. [London], vol. 13, no. 781, pp. 221-223, June 8, 1844.

Describes the warping or flooding of land with silt-laden water at high tide so that by means of sluices and channels the sediment would be deposited to build up and enrich the land. It was first practiced in England on the banks of the Humber a century before. Describes warping in Val di Chiana, Italy, and on the Trent, Don and Ouse in England. Discusses the warping of 1500 acres on the Ouse by Creyke in 1825.

5. Improvements of old fields [letter to editor]. South. Cult. (ser. 1), vol. 6, no. 9, pp. 132-133, Sept. 1848.

Calls attention to the rich alluvial deposits in branches and creek bottoms in Greene, Morgan, Hancock, Baldwin, Jones, Jasper, and Putnam Counties, Ga. and recommends their use in improving the exhausted lands. Describes experiment in use of deposits from freshet for fertilizing land. Gives advice on amounts and methods of application and the effect of silt on different crops.

6. The Port of Calcutta and River Hooghly. Engineering, vol. 1, p. 195, Mar. 30, 1866.

Describes the Port of Calcutta and the River Hooghly in India. Describes the silt-laden condition of the Ganges and Hooghly Rivers and notes that the average quantity of solid matter in the Hooghly River is more than 1 cu. in. to 1 cu. ft. of water; 39,000,000 cu. yd. of matter pass Calcutta per annum, and 78,000,000 cu. yd. pass between Roopnarain and the sea. Matter is deposited in shoals at bends, also in sandbanks at sea. The effect of tides on the river is mentioned.

7. The Port of Calcutta and River Hooghly. Engineering, vol. 1, pp. 213-214, Apr. 6, 1866.

Describes historically the impediments to navigation at the mouth of the Hooghly River, noting the existence of bars in channels and the need for channel fixedness.

8. Port of Calcutta and River Hooghly. Engineering, vol. 1, pp. 342-343, May 25, 1866.

Gives the probable causes of formation of deposits in the Hooghly River bed in India. Discusses the effect of tides, velocity, points of obstruction, bank erosion, variation in river width, and action of tributaries on the deposition of silt.

9. Irrigation in Spain. Engineering, vol. 3, pp. 291-292, Mar. 29, 1867.

Describes the dam on the Segura River and the ancient reservoir in the Elche basin against which great deposits of silt rest. Notes means of removing silt, including the use of sluices to clean canals of silt deposits.

10. The Suez Canal. Engineering, vol. 7, p. 125, Feb. 19, 1869.

Describes the success of the Suez Canal enterprise in spite of difficulties encountered. Includes one paragraph noting a proposal to make solid work of the open sea wall to prevent silting up of the northern entrance to the canal by sand and alluvium brought down by the Nile River. Also notes that fine desert drift sand

- passes into the length of the canal requiring annual dredging.
11. Fluvial abrasion. *Engineering*, vol. 7 pp. 423-424, June 25, 1869.
Comments on The Abrading and Transporting Power of Water (Login, T., 1). Discusses the power of a stream in transporting material in suspension as affected by velocity, noting conditions on the Po River, Italy. Takes exception to Login's views as to expenditures of the energy of a stream in transporting material in suspension.
 12. Rivers; their function and their treatment. Van Nostrand's *Engin. Mag.*, vol. 4, pp. 409-417, Apr. 1871.
Deals with the function of rivers (internal navigation, etc.) and with their improvement. Includes discussions on bar formation and elimination and on bank erosion and protection.
 13. Bear River tunnel scheme. *Engin. and Mining Jour.*, vol. 16, no. 12, p. 188, Sept. 16, 1873; also in *Mining and Sci. Press*, Aug. 30, 1873.
An article on the effects of hydraulic mining along the Bear River in California, and on silting and floods in that River. Process of formation of alluvial bottom land is described. Annual increment of tailings amounted to from 10 to 20 ft, occupying the river bed for more than 60 miles from Elmore Hill, near Dutch Flat, to the mouth of the River. The depth of the alluvial deposit varies from 20 ft. to 100 ft. and the width from 100 ft. to 500 ft. Some of the newly made land has been cultivated with success.
 14. Mouth of the Mississippi. *Engineering*, vol. 19, pp. 81-83, illus., Jan. 22, 1875.
Discusses and gives extracts of controversial literature published by Gen. Humphreys and Capt. Eads on various aspects of transportation and deposition of sediment in the lower Mississippi River, including the efficiency of silt-laden water in bank erosion, the effect of salt water on bar formation at the mouth of the river, the growth of the delta at the rate of 8-9 in. per yr., and controversial statements on the effect of natural levees on bar formation at the mouth and the relation between velocity of current and transported matter. Gen. Humphreys' explanation of the formation and advance of bars at the mouth is based on his assertions that there is a mass of bed load being pushed along the bottom throughout the whole course of the river and that where fresh water meets salt water the fresh water rises above it creating a "dead angle" of salt water on the seaward side of the bar where the bed load is deposited. Capt. Eads attacks this theory by stating that no such "dead angle" exists due to action of Gulf currents and that his experience with a diving bell showed no bed load in the Mississippi either during flood or at other times.
 15. The lessons of the Szegedin disaster. *Engineer*, [London], vol. 47, pp. 263-264, Apr. 11, 1879; [abstract], *Engin. News*, vol. 6, p. 130, Apr. 26, 1879.
Gives features of the inundation of Szegedin on the River Theiss, Hungary, and the lessons derived from the disaster. Discusses the transportation and deposition of silt and its effect on raising the stream-bed level. Presents a brief comparison of the value of river control by levees and by dredging and notes the advantages of dredging operations.
 16. The Des Moines River [extract]. *Engin. News*, vol. 6, p. 152, May 10, 1879.
Extract of news item from the State Gazette, Des Moines, Iowa, noting that in removing the old railroad bridge over the Des Moines River it was found that sediment 10 ft. deep had collected in piers. The bridge had been standing 11 yr.
 17. Missouri River sediment. *Engin. News*, vol. 7, p. 206, June 12, 1880.
A news item presenting results of daily sediment observations taken for one year on the Missouri River at St. Charles, Mo. The average quantity of earth carried in suspension past that point daily, between 1 ft. of the bottom and the surface, amounted to 12,837,312 cu. ft. weighing approximately 100 lbs. per cu. ft. The mean amount borne daily during June and July was determined as 47,396,483 cu. ft.
 18. Floating scouring dam. *Engineering*, vol. 34, p. 121, illus., Aug. 4, 1882.
Describes the Kingston floating scouring dam which was tried on the River Welland. The floating dam scoured the silty loamy bottom of the stream and charged the water with all it could carry away in suspension.
 19. The mechanics of river channels. *Amer. Engin.*, vol. 4, no. 27, pp. 294-296, Dec. 29, 1882.
Comments on the principles propounded by M. Fargue on the mechanics of river channels in *Annales des Ponts et Chaussees*, 1882. Discusses M. Fargue's deductions which are based on knowledge of the transportation and deposition of solid matter in flowing water.
 20. Erosion of Mississippi River bed. *Engin. News*, vol. 10, p. 150, Mar. 31, 1883.
Discusses the possibility of the Mississippi River seeking a new outlet, via the Bayou Atchafalaya, diverting so much flow from the present stream bed that it would drop its sediment load in its present bed, thereby permanently separating New Orleans from an outlet to the sea. The diverted route would cut 125 miles from the length of the river. Between 16 and 40 percent of the Mississippi River flood flow goes through the Atchafalaya, the scour of which caused the channel to increase in depth by 70 ft. between 1862 and 1882, (15 ft. between 1877 and 1882). The mouth of the Atchafalaya must be dammed soon (1883) to prevent its becoming the main outlet of the Mississippi.
 21. Hydraulic mining. *Engin. News*, vol. 11, p. 61, Feb. 9, 1884.
Notes the filling of the Yuba, Feather, and Sacramento Rivers with sluicings from hydraulic mining operations upstream. Much farm land is submerged in floods and covered with a sedimentary deposit 1-10 ft. in depth. The bed of the Feather River at Marysville has raised 15 ft.; at Sacramento, 6 ft.; and San Francisco Harbor has been injured. Brush check dams were tried but were carried away by freshets or destroyed by fire. A permanent injunction against hydraulic mining operations was granted.
 22. Shifting of the Mississippi channel. *Sci. Amer.*, vol. 50, no. 12, p. 184, Mar. 22, 1884.
Notes observations by Capt. Marshall and Maj. Harold of the U. S. Mississippi River Commission evidencing the movement of bed load in the Mississippi River. A pile, placed to mark the end of a dike during high water, moved downstream 62 ft. remaining erect and firmly embedded in the sediment.
 23. Floods in the Mississippi. *Engineering*, vol. 37, pp. 459-461, May 23, 1884.
Relates to Capt. J. B. Eads' work on improvements to the Mississippi River at its mouth and proposed improvements through its alluvial basin to prevent floods. Discusses relationships between velocity and depth with the ability of the stream to carry matter in suspension, and notes that this relationship gives the river the power of altering its slope. This relationship was erroneously discussed by Generals Humphreys and Abbot at an earlier date. Gives an extract of the report of the Mississippi River Commission, by Captain Eads (Van Nostrand's Magazine, 1878) showing that the current alters slope by opposite processes of deposit and scour. To reduce the slope the current must temporarily increase by a reduction of width or by an increase in volume of water, to decrease friction. To lower floods and deepen channels it is necessary to close outlets and crevasses of levees and convey waters through one channel to the sea. Humphreys and Abbot previously made statements to the contrary. Notes the occurrence of a cut-off at the mouth of the Red River into Atchafalaya resulting in silting up of the upper end and depriving the Mississippi of one-sixth of its volume.

ANONYMOUS. - Continued

24. River beds in lake bottoms [abstract]. *Amer. Met. Jour.*, vol. 3, no. 1, pp. 5-6, May 1886.
Summarizes briefly the results of investigations by the Swiss Topographical Bureau on the sub-aqueous flow of the Rhone and Rhine Rivers through Lakes Constance and Leman. The phenomenon is due to differences in density and temperature of river and lake waters.
25. Forests and floods in southern California. *Amer. Met. Jour.*, vol. 3, no. 9, pp. 405-407, Jan. 1887.
Six-paragraph news item briefly noting conditions of erosion and of the deposition of erosional debris by streams of southern California resulting chiefly from watershed denudation by fire.
26. Agricultural engineering in India I. *Engineering*, vol. 45, pp. 341-342, illus., Apr. 6, 1888.
Discusses the necessity for irrigation in the Do-ab country in northern India. Describes the flat alluvial plain of Do-ab formed by debris washed down the Ganges and Jumna Rivers from the mountains. The method of transportation and deposition of debris, the effect of clay strata in maintaining the supply of water in wells, and the formation of "reh" or salt deposit and use of lime formation or "kun-kur" originating from sediment, as a hydraulic lime are discussed.
27. Agricultural engineering in India VI. *Engineering*, vol. 46, pp. 15-17, illus., July 6, 1888.
Discusses agricultural engineering in India with special reference to the construction of canal headworks on the Ganges River. Describes the character of the river at Hurdwar, noting the existence of boulders of various sizes on the river bed; the construction of Ganges Canal headworks, weirs, dams and bunds; and the effect of floods on headworks. Notes the existence of islands, mainly of sand, formed by the river. Revetment construction for bank protection is noted.
28. Kingston's floating scouring dam; Hidgellee tidal canal lock. *Engineering*, vol. 46, pp. 403-404, illus., Oct. 26, 1888.
Notes the applicability of Kingston's floating scouring dam (*Engineering*, Aug. 4, 1882), for clearing silt deposits in channels between the Hidgellee tidal canal locks in India. Notes that 8-10 ft. of sediment is deposited in lock channels. Describes the construction and mode of operation of the scouring dam, 6 in.-2 ft. being scoured from the bed in a single operation.
29. Agricultural engineering in India XII. *Engineering*, vol. 46, pp. 471-473, illus., Nov. 16, 1888.
Discusses the silt problem in canals of the North-West Provinces, India. Notes the effects of canal silting. Silt has a beneficial effect as a destroyer of weeds by excluding light, as a sealing agent to prevent percolation from canals, and as a fertilizer. Discusses canal construction to permit self-establishment of a permanent regime by cutting and silting. Outlines problems of silting in the Ganges Canal, India, noting remedial measures.
30. The Nochistongo Cut, and the drainage of the Valley of Mexico. *Engin. News*, vol. 23, no. 15, pp. 339-341, Apr. 12, 1890.
Describes drainage conditions of the Valley of Mexico and historical attempts to drain the valley. Includes one paragraph noting that unwise cutting down of forests since the Spanish conquest has resulted in the filling up of the Lake Texcoco bottom with alluvial matter carried in great quantities annually by streams pouring into the valley from surrounding mountains. The bottom of the lake is raised about 1 1/2 in. annually by deposited silt, raising the normal water level and causing frequent inundations.
31. Improving the Mississippi's channel [extract]. *Engin. and Bldg. Rec.*, vol. 22, no. 21, p. 327, Oct. 25, 1890.
This extract of an article published in Harper's Weekly discusses theories of Mississippi River improvements, including the theory of restricting the river within boundaries to cause velocities to maintain scour beds, noting the work of Captain Eads at the South Pass of the Mississippi River, the theory of removing obstructions and providing new outlets, and the theory of confining waters in artificial reservoirs.
32. Silting in irrigation distributaries. *Indian Engin.*, vol. 12, no. 24, p. 498; no. 25, pp. 531-532, illus.; no. 26, pp. 551-552; no. 27, pp. 571-572, illus., Dec. 10-31, 1892.
Discusses and presents results of observations on the relationship of width and depth of the silt-carrying capacity of irrigation distributaries.
33. The Nile Corvée. *Engineering*, vol. 56, pp. 52-53, July 14, 1893.
Describes a system of forced labor (corvée) to protect banks of the Nile River, Egypt. Notes that if waters at the neck of the Delta were headed up 14 ft., clearance of the silt would be reduced to a minimum; also that the increased amount of bank protection due to silting up of deep summer canals and the increase in surface of irrigated fields necessitated an increase in corvée.
34. The New York State canals. *Engin. News*, vol. 35, no. 4, pp. 43-44, Jan. 16, 1896.
Discusses improvements to the canals of New York. Includes one paragraph noting that gradual accumulations of deposits in the Erie Canal prism in 25 yr. amounted to 2,250,000 cu. yd. and to proportional amounts in other canals. The adoption of new methods of propulsion and hard work succeeded in keeping narrow channels deep enough for navigation.
35. The Sirhind Canal and its difficulties. *Indian Engin.*, vol. 21, pp. 31-32, Jan. 9, 1897.
The writer discusses and corrects some mis-statements which appeared in the *Pioneer*, Nov. 10, 1896, relative to silting in the Sirhind Canal.
36. The River Hooghly. *Indian Engin.*, vol. 21, pp. 433-434, June 5, 1897.
Presents various hydraulic data concerning the River Hooghly and its tributaries with especial reference to the improvement of the stream for navigation. Includes discussion on the quantity of alluvium carried by the stream and on the character of the bed of the stream and its tributaries.
37. The Mississippi River floods and methods for their control [abstract]. *Engin. News*, vol. 41, no. 4, pp. 50-52, Jan. 26, 1899.
Abstract of report on Mississippi River floods and methods for their control. Includes three paragraphs giving historical data on improvements to outlets at mouth of the Mississippi by dredging and by construction of jetties to maintain navigable channels.
38. The Mississippi floods, their cause and prevention [abstract]. *Engin. Rec.*, vol. 39, no. 9, pp. 184-187, Jan. 28, 1899.
An abstract of report to the Committee on Commerce of the United States Senate on the cause and prevention of floods on the Mississippi River. Discusses bank protection works, channel contraction by jetties at passes, use of spur dikes and dredging. Break in Pass a Loutre in 1891 resulted in decreased flow through South Pass, where jetties maintained navigable depths, thereby reducing scouring effect and causing silt to be deposited in channel. Notes need for continued maintenance of river regulation works. Discusses proposed improvements on Southwest Pass of the Mississippi and on the Missouri River.
39. On the silting-up of the reservoir at Austin, Texas. *Engin. News*, vol. 43, no. 8, p. 128, Feb. 22, 1900.
Editorial comment on The Silting-up of Lake McDonald and the Leak at the Austin Dam, (Taylor, T. U., 2). Notes that waste and scouring conduits might have been provided at Austin Dam to remove deposits.
40. The problem at the mouth of the Mississippi River. *Engin. Rec.*, vol. 42, no. 11, p. 241, Sept. 15, 1900.
Discusses the problem at the mouth of the Mississippi River since the completion of improvement works at the mouth of South Pass. Construction of the new jetties parallel to the ori-

- ginal jetties and of wing dams or groins to accelerate velocity and to increase scour resulted in overcontraction leaving a pool-like condition above the contracted places. Outlets on the river above the passes decreased flow through the passes with attendant evils of silt deposition. Notes increased formation of crevasses in the Pass à Loutre and the effect of sand waves in South Pass. Discusses the application of the jetty method of channel improvement to Southwest Pass.
41. The use of water in irrigation. *Engin. News*, vol. 45, no. 9, pp. 158-159, Feb. 28, 1901.
Discusses the use of water in irrigation, the necessity of ascertaining amounts of water needed, methods of measuring water, losses of water due to seepage and evaporation, and method of computing amounts of water discharged through irrigation canals. Includes two paragraphs noting that sediment investigations indicate that southern streams in flood time carry as high as 5 percent of solid matter in suspension, necessitating the cleaning of canals which derive their water from them. Sediment deposits above weirs in canals affect the velocity of approaching water, and sluicing devices are needed to remove accumulated deposits.
 42. Effect of deforestation. *Forestry and Irrig.*, vol. 8, no. 4, p. 146, Apr. 1902.
Illustrates the influence of denudation upon discharge of sediment in a stream. Notes observations of sediment discharge, carried on at the Salt River Reservoir site on Tonto Creek and Salt River in Arizona, to compare relative amounts of sediment contributed by the two streams. Results of observations show that Salt River below the mouth of Tonto Creek carried .00146 percent of sediment while Tonto Creek, 1/2 mile above its mouth, carried .00275 percent. Notes that the Tonto basin is heavily grazed and almost bare of timber, grass, and other vegetation, while the Salt River basin is mainly timbered and well carpeted with grass.
 43. Proposed retaining barriers for the debris from hydraulic mining in the Yuba River, Cal. *Engin. News*, vol. 49, no. 3, pp. 52-53, illus., Jan. 15, 1903.
Describes proposed mining debris retaining barriers in the Yuba River, Calif. Notes that in 1880, the estimated accumulated tailings of the bed of the Yuba River amounted to 140,000,000 cu. ft. Describes the brushwork and log cribbing barriers as types of barriers in use. Outlines details of proposed Barriers Nos. 1 and 2 on the Yuba River noting provisions for increasing height of barriers to keep pace with sedimentation.
 44. Debris Barrier No. 1, Yuba River, California [abstract]. *Engin. News*, vol. 53, no. 24, pp. 609-610, illus., June 15, 1905.
Describes site and construction details of Debris Barrier No. 1 on Yuba River, Marysville, Calif. The project provides for holding and storing mining debris by works designed to separate coarse material from fine and to confine the low-water channel in the lower reaches within narrower limits to hold extensive deposits already there. Proposes the use of four restraining barriers in the bed of the river and a settling basin adjoining the river on the south, also two upper barriers to retain coarser material, and a settling basin to cause deposition of finer material carried in suspension. Describes the site and gives a detailed description of Barrier No. 1, as well as of previous efforts of the California Debris Commission to build barriers across the Yuba River.
 45. The irrigation of Egypt. *Engineering*, vol. 79, pp. 759-760, June 16, 1905.
Describes historical irrigation methods in Egypt. Notes that the cultivable soil of the country owes its origin to accumulated deposits of silt brought down annually by the Nile River when in flood. Describes an ancient lake dug about 2000 B.C. which vanished when the canal to it became silted. The lake bottom is now fertile valley.
 46. Drift silt and channel discharge. *Indian Engin.*, vol. 40, pp. 145-146, Sept. 1, 1906.
Deals with the effect of drift silt (shifting bed material) upon the discharge of a channel.
 47. Silt and scour. *Engineer* [London], vol. 102, pp. 391-392, Oct. 19, 1906.
Discusses and comments upon Bellasis' condemnation of the "still water theory" of silt deposition.
 48. Analyses of James River water [abstract]. *Amer. Geog. Soc. Bul.*, vol. 40, no. 6, pp. 352, 1908.
Presents briefly the results of investigations by the U. S. Geological Survey which indicate that James River carries annually past Richmond, Va., 1,100,000 tons of mineral matter, of which 380,000 tons is silt transported in suspension. Notes the source of suspended matter.
 49. Scouring velocities [abstract]. *Engin. Contract.*, vol. 29, no. 20, p. 300, May 13, 1908.
Abstract of a paper on sedimentation and its relation to drainage, read before the Illinois Society of Engineers and Surveyors. Includes a table showing scouring velocities of material of various sizes. In a discussion of the paper it is noted that results of observations in the Coal River, W. Va. show that fine sand moves when velocity is as low as 0.8 ft. per sec.
 50. Utilization of pond mud. *Agr. News* [West Indies], vol. 7, no. 161, p. 202, June 27, 1908.
Notes the utilization of mud cleared out of ponds at the lower end of fields at Kew and Nottinghamshire, Great Britain, the chemical composition of samples, and the value of mud as fertilizer.
 51. Map of watershed Loch Mary. Bee (Earlington, Hopkins County, Ky.), vol. 20, no. 10, illus., Mar. 11, 1909.
Newspaper article and map of the watershed of Loch Mary describing a silt survey made in December 1908 after the lake had been in existence 20 yr. During this period 70,692 cu. yd. of sediment from 2440.89 acres of watershed had been deposited in the reservoir. Gives areas of watershed in forest and in cultivation.
 52. Methods of protecting railway embankment along streams from current action, with some costs [abstract]. *Engin. and Contract.*, vol. 37, no. 7, pp. 189-193, illus., Feb. 14, 1912.
Describes the design of various works for the protection of river banks. Design of the Kerr gabion system which utilized the law of sedimentation is described.
 53. Method of estimating the probable volume of silt deposits in river storage reservoirs for the Oklahoma City water supply. *Engin. and Contract.*, vol. 39, no. 11, pp. 290-293, Mar. 12, 1913.
Discusses the silting up of storage reservoirs with special reference to the proposed reservoir on the North Canadian River at Oklahoma City, Okla. Describes general conditions of reservoir silting in the Southwest, noting in particular conditions of silting behind the old Austin Dam in Texas, giving rates of silting, distribution of sediment in the reservoir, and the relationship between runoff and silt deposit. Discusses the relationship between the percentage of sediment by volume and the percentage by weight, giving data for the Brazos, Washita, and Colorado (at Yuma) Rivers, and the Rio Grande. Notes the effect of standing for 30 days and for 1 yr. on the silt volume in samples. Results of observations on the amount of silt deposited in sedimentation basins of the Oklahoma City filtration plant during 1912, flow of river, and the corresponding sediment carried, are given; also the amount of sediment removed from settling basins at St. Louis (Mississippi River) 1884-95; and a summary of observations on silt deposit and volume of sediment for the Brazos River at Jones Bridge, Tex. (1899), the Wichita River at Wichita Falls, Tex. (1900 and 1901), the Colorado River at Wharton, Tex. (June, July and August 1903), and the Rio Grande at El Paso, Tex. (February, May, April and June 1901 and

- 1902). Data on silt deposits in the Colorado River at Yuma, Ariz. are discussed, and a summary of silt determinations is given. Data on estimated silt accumulations in the proposed storage reservoir receiving total river flow from the North Canadian River at Oklahoma City, and on estimated silt in the reservoir receiving city consumption only and located outside the river bed, are given. Notes the effect of the period of detention of water in the reservoir on the amount of silt accumulations.
54. A solution of the silt-removal problem in harbor maintenance. *Engin. News*, vol. 69, no. 19, p. 967, May 8, 1913.
Editorial discussing the cost of improving the harbor at Wilmington, Del. since 1836 by dredging, etc. Notes use of Fruhling type suction dredge to clear silt accumulations and maintain navigable channel.
55. The filtration of river waters in India. *Engineering*, vol. 96, pp. 784-787, illus., Dec. 12, 1913.
Describes means of purifying the river waters of India for domestic use by decantation and filtration, and means of maintaining an adequate supply. Notes that Indian rivers are excessively turbid, increased flow increases turbidity, and maximum turbidity of the Ganges River slightly exceeds 200 pts. per 100,000 of total solids. Ganges River silt consists of fine clay and lime.
56. Maintenance excavator at Orland Reclamation project in California. *Engin. Rec.*, vol. 69, no. 15, pp. 428-429, illus., Apr. 11, 1914.
Describes a traveling excavator permanently installed to clean and keep serviceable canals at the south diversion of the Orland Reclamation project, Calif.
57. Mud and salts in western rivers [extract]. *Engin. News*, vol. 73, no. 17, p. 823, Apr. 29, 1915.
Extract from a U. S. Geological Survey bulletin noting annual discharge of 338,000,000 tons of suspended silt from the Colorado River into the Gulf of California, also 19,500,000 tons of dissolved salts, or 20 tons per square mile drained. Estimates an annual discharge of 1680 tons of dissolved salts per square mile drained by the Elm Fort of Red River in Oklahoma.
58. Study silt problems Imperial Valley stream. *Engin. Rec.*, vol. 73, no. 6, p. 182, Feb. 5, 1916.
Gives results of an examination of samples of water taken from the canal at Hanlon Heading, Imperial Valley, by means of a trap door which secures samples at various depths. Figures of the California Development Co. show that 30,024,000 cu. yd. of solid matter passed through Hanlon headgates during 1914. The total amount of silt taken from the canal in 1914 by dredging and other methods represents 13 percent of the total solids passing through the headgate, a difference of more than 26,000,000 cu. yd. either deposited on lands, discharged into Salton sea, or left to accumulate in canal systems. The cost of removal is given. Half of the solids brought down by the water are carried in suspension, the other half roll along the bottom. An increase in the quantity of fine material not only increases the total load carried, but a greater quantity of coarse material is transported. Discusses the depth-to-width ratio in canals to avoid silting so that material carried in suspension may be deposited on lands. Notes the possible use of a skimming weir to keep heavier sediment from entering the canal.
59. Bank protection above Sibley Bridge: Santa Fe Ry. *Engin. News*, vol. 75, no. 14, pp. 638-640, illus., Apr 6, 1916.
Describes the riverbank protection above Sibley Bridge, Santa Fe Ry., on the Missouri River. Discusses the series of dikes built and a three-matress system utilized. Tables show cost and quantities of lineal feet protected. Includes specifications for bank protection, piles and weaving of mattresses.
60. Notes on silting of Elephant Butte Reservoir. *Reclam. Rec.*, vol. 7, no. 9, pp. 423-425, Sept. 1916.
Summarizes a study of the silt problem at Elephant Butte Reservoir made by R. R. Coghan and Victor E. Lieb in 1916. Discusses the determination of the weight of moisture-free sediments in a cubic foot of deposited material from a reservoir bottom and the sequences of deposition of these sediments. Notes the weight of a cubic foot of river silt. Using the records of silt passing San Marcial from 1897 to 1912, the life of the reservoir is estimated to be 233 yr.
61. Solve silt problem on Yuma irrigation project [abstract]. *Engin. Rec.*, vol. 74, no. 14, p. 406, Sept. 30, 1916.
Briefly notes the silt problem of the Yuma irrigation project and describes methods of silt removal from the canal system.
62. Silt observations at Yuma gaging station. *Reclam. Rec.*, vol. 8, no. 5, pp. 240-241, illus., May 1917.
Discusses silt observations at the Yuma gaging station on the Colorado River by the U. S. Reclamation Service since 1909. The 4000 recordings, which were made triweekly at 3 points on the Lower Colorado River, (at 3 depths at each point) have been compiled and made available. The relative silt content of the Colorado and Gila Rivers can be ascertained. The Colorado River bottom is shifting silt, scouring and filling as the velocity of the river increases and decreases. A cross section of the river bottom at the station has varied from 1410 sq. ft. to 25,000 sq. ft. (discharge varied 34,500 sec.-ft. in 1904 and 112,000 sec.-ft. in 1914). Summarizes data on the maximum percentage of silt at various discharges; the maximum and mean percentage of silt by weight; the weight of wet and dry deposited silt; and specific gravity. Compares quantity and weight of silt carried by the Colorado with that of other streams.
63. Fighting silt in the Colorado River. *Earth Mover*, vol. 3, no. 5, pp. 15-16, illus., July 1917.
Briefly describes the engineering features of the Rockwood Intake Gates on the Colorado River, below Yuma, Ariz. Notes that the intake was undertaken largely to get rid of silt, and comparatively clean water will be skimmed off the top of seventy 8-ft. gates. Brief data are given on the average annual quantity of silt carried to sea by the Mississippi, Nile, and Colorado Rivers.
64. Alaska's glacial silt rapidly erodes needle tips of waterwheels. *Engin. News-Rec.*, vol. 79, no. 5, p. 229, illus., Aug. 2, 1917.
Describes the abrasive action of suspended glacial silt, varying in size from fine glacial flour to ordinary quartz sand, on waterwheel parts of the hydro-electric plant of the Alaska Treadwell mine on Nugget Creek, Alaska.
65. Clean old ditches to take run-off from bluffs without silting. *Engin. News-Rec.*, vol. 80, no. 23, pp. 1083-1084, illus., June 6, 1918.
Discusses impaired efficiency caused by silting in Farmers Ditch and Drainage District No. 1, Woodbury County, Iowa, and methods of cleaning ditches. Slipping of banks in the main ditch obstructed the channel and caused partial filling with silt. Topography of the district is such that, when the silt-laden discharge is excessive, water from the main ditch backs into laterals and deposits silt. Describes remedial measures and machines used in cleaning ditches.
66. Groynes as applied to water control and silt exclusion. *Indian Engin.*, vol. 64, no. 12, pp. 166-167, illus.; no. 14, pp. 194-195, illus.; no. 15, pp. 206-208, illus.; no. 16, pp. 222-223, illus., Sept. 21, Oct. 5-19, 1918.
Deals with the application of a modification of the Bell Bund System to the canal practice of silt exclusion. Describes the beneficial action of groynes, suitably located, in the exclusion of silt from inundation canals; cites an example of the use of a groyne at the Manka Canal head, Indus Series, India.
67. Protection of river banks [abstract]. *Engin. and Contract.*, vol. 52, no. 5, p. 125, July 30, 1919.
Abstract of article in *Schweizerische Bauzeitung*. Discusses the use of a precise type of

- bank protection based on a constant or erosion factor developed from the hydraulic gradient and depth of a stream.
68. Movement of silt, Elephant Butte Reservoir. *Engin. World*, vol. 15, no. 9, p. 39, Nov. 1, 1919.
Notes that the silt underflow through Elephant Butte Reservoir during July 1919 resulted in a discharge of 2,500 acre-feet of silt through the gates. Silt carried in irrigation waters sealed new ditches and canals constructed of sandy material. Causes of the underflow movement are noted.
 69. Templet used in clearing sand from irrigation canals. *Engin. News-Rec.*, vol. 83, no. 18, pp. 800-801, Oct. 30/Nov. 6, 1919.
Describes methods used for removing drift sand from the main canal of the Umatilla Irrigation Project, Oreg. Describes the operation of sluiceways and templet to clear the canal. Notes protective bank work to maintain clearance.
 70. Silt problem of river reservoirs. *Engin. News-Rec.*, vol. 84, p. 145, Jan. 15, 1920.
Notes the average annual storage loss of Zuni Reservoir, Lake McMillan, N. Mex., and Lake Austin, Tex. Discusses silt content of the Rio Grande, Conita Creek, and Moencopi Wash, Ariz., and the Kaw River, Kans. The large amount of silt carried (more than 80 percent in some cases) has been taken to indicate the great eroding power of floods. Although this may apply to large streams it does not seem to apply to the flashy streams of the Southwest, where a smaller volume of runoff may carry a greater quantity of silt. It is suggested that this may be explained by the dryness, and greater erodibility, of the ground during periods of low runoff as compared with periods of greater runoff when the ground is moist and not so easily eroded. Discusses feasibility of various methods of removing silt from the Zuni Reservoir. Ripping of shores and placing large sluices in the dam are considered of doubtful utility. The only feasible method is believed to be the use of an automatic suction dredge with floating pipe line attached to the lowest outlet in the dam, and even this would involve difficulties during dry seasons when the silt would have to be discharged into the canal to prevent wastage of water.
 71. Scouring silt from canals. *Reclam. Rec.*, vol. 11, no. 8, p. 379, illus., Aug. 1920.
Deals with an "A" frame type of device used to scour silt in the canal of the Mapleton Irrigation District, Utah, during 1919.
 72. Device for scouring silt from irrigation canals. *Engin. and Contract.*, vol. 54, no. 10, p. 244, illus., Sept. 8, 1920.
Describes a wooden A-frame device used to scour out silt deposits from the upper end of the main canal of Mapleton Irrigation District, Utah. The device is weighted with rock and made a settle to the bottom of the canal, in which position it is gradually moved downstream to new positions where desired scouring action is required.
 73. Missouri River banks protected by tree retard. *Engin. News-Rec.*, vol. 87, no. 24, pp. 966-968, illus., Dec. 15, 1921.
Describes the method of bank protection on the Missouri River, north of Omaha, Nebr., using spur dikes or current retards to stop erosion and promote silting. Deposition of sediment below one retard produced a fill averaging 10 ft. deep, 100 ft. wide, and 800 ft. long in about two weeks.
 74. Umfolozi Irrigation Board. *So. African Irrig. Dept. Mag.*, vol. 1, no. 2, p. 61, Jan. 1922.
Notes that the Umfolozi River is a good example of a large river building up a great alluvial plain.
 75. Physics of large alluvial Indian rivers. *Indian Engin.*, vol. 71, pp. 39-41, Jan. 21, 1922.
Deals with the behavior of alluvial rivers in Upper India. Describes characteristic meandering, silt transportation and deposition, flood effects, river training, factors causing variations in river course, action of alluvial streams in delta areas.
 76. Report on hydraulic problems of the Colorado River. *Reclam. Rec.*, vol. 13, no. 3, pp. 41-45, Mar. 1922.
Discusses flood and irrigation control of the Colorado River, noting studies of reservoir sites and canal routes for the Imperial Valley and the valley of the lower Colorado. Notes silt observations at Yuma, just below the mouth of the Gila River, showing annual average silt volume of 113,000 acre-feet on the assumption of 85 lbs. of dry matter per cu. ft. of solid. Silt content of the Colorado, when the Gila is not in flood, averages 0.5 percent. Silt at Boulder Dam would amount to 88,000 acre-feet per annum.
 77. Silt in the Vaal River. *So. African Irrig. Dept. Mag.*, vol. 1, no. 3, p. 116, Apr. 1922.
Presents a compilation of data regarding silt carried by the Vaal River, South Africa.
 78. Silt in the Orange River. *So. African Irrig. Dept. Mag.*, vol. 1, no. 4, pp. 175-176, illus., July 1922.
Presents observations on the silt content of the Orange River, Union of South Africa, tending to show the relationship between discharge of stream and percentage of silt carried. Silt determinations for the Vaal and Fish Rivers are given.
 79. Silt in lower Orange River. *So. African Irrig. Dept. Mag.*, vol. 1, no. 5, pp. 245-246, Oct. 1922.
Gives results of silt observations and flood discharges on the lower Orange River at Kakamas, Union of South Africa, during the flood season of 1919-20. Notes that the silt content of the stream varies directly with the intensity of flood, that silt content is greater after the flood peak than before, and that the average percentage of silt carried down by floods of the lower Orange River is approximately 75 percent by weight.
 80. Changes in the Nile Delta and lower Nile; the Delta lake fisheries. *Geog. Rev.*, vol. 13, no. 4, pp. 618-620, 1923.
Discusses changes in topography of the Nile Delta noting number of present and ancient channels of Nile through its Delta to the Mediterranean. Cites evidence to show influence of man-made canals in determining routes of Nile distributaries. Describes Lake Manzola and other shallow lakes on the Nile Delta.
 81. Reconstruction of Hell Gate Dam to eliminate silt. *Engin. News-Rec.*, vol. 91, no. 26, pp. 1055-1058, illus., Dec. 27, 1923.
Shows results obtained by using four large sluice gates in the Hell Gate Dam of the Missoula, Mont., Light and Water Co., for the purpose of sluicing pondage silt from the reservoir in back of the dam. Use of these gates caused serious undermining of the timber crib training wall between the gate discharge and the tailrace, necessitating reconstruction of the wall. Gives a description of the sluice gates and the diversion wall, both original and as reconstructed. Outlines construction methods.
 82. Current retards on American rivers. *Engineer [London]*, vol. 136, pp. 689-691, illus., Dec. 28, 1923.
Describes details of construction and the use of current retards as a means of bank protection by induced sedimentation.
 83. [Review of] Regulation of rivers without embankments, by F. A. Leete and G. C. Cheyne. *Engin. News-Rec.*, vol. 94, no. 21, p. 863, May 21, 1925.
Reviews the book (Leete, F. A., 1). The control of the Rangoon River headwaters by the Mytaka Training Works is discussed in detail. These training works consist of bamboo fences to cause silt stoppage and the automatic building up of river banks.
 84. Silting in the Truro River [abstract]. *Engineer [London]*, vol. 142, no. 3702, p. 697, Dec. 24, 1926.
Notes the extent of silting in the Truro River, England, and describes proposed means and costs of dredging operations and river improvement on the stream.

85. [Review of] *Geschiebebewegung in Flüssen und an Stauwerken* (rubble movement in rivers and weirs). by A. Schoklitsch. *Water and Water Engin.*, vol. 29, no. 337, p. 39, Jan. 20, 1927.
A review of *Geschiebebewegung in Flüssen und an Stauwerken* (108 pp., Vienna, J. Springer, 1926), which discusses conditions of bed-load movement in streams and describes results of field and laboratory observations on the effect of bed-load upon the design and operation of weirs.
86. Ithaca reservoirs. *Cornell Civ. Engin.*, vol. 36, no. 3, p. 65, Dec. 1927.
Describes the effect of the demolition of the dam and the sediment-filled reservoir on Casa-dilla Creek, N. Y., upon conditions of sedimentation below the dam, and notes conditions of sedimentation in Beebe Lake behind University Dam at Triphammer Falls, N. Y. Notes the need for measures to control sedimentation in Beebe Lake.
87. Po River flood-control works. *Engin. News-Rec.*, vol. 100, no. 9, pp. 361-362, Mar. 1, 1928.
Article on flood-control works of the Po and Adige Rivers in Italy, particularly noting levee and dike construction, river-bed levels, levee heights, and rates of building deltas. Comparison with conditions in the Mississippi is noted. Based on John R. Freeman's paper to be presented before the American Society of Civil Engineers (Freeman, J. R., 6).
88. Stevenson Creek (California) arch dam. *Franklin Inst., Jour.*, vol. 205, no. 4, pp. 549-551, Apr. 1928.
Note communicated by the Director of the U. S. Bureau of Standards describing various engineering tests on the Stevenson Creek Arch Dam near Fresno, Calif. Includes one paragraph noting that the floods of 1927 caused the deposition of rock, sand, and silt in the reservoir to an average depth of 40 ft. at the upstream face of the dam.
89. Prevention of silt deposits in conduits. *Elect. West*, vol. 60, no. 6, pp. 396-406, illus., May 15, 1928.
Considers the use of "sand traps" and settling basins to remove debris from conduits. Treats transportation of debris by flowing water, using much of the material put forth by G. K. Gilbert in Professional Paper 86 of the U. S. Geological Survey, entitled *The Transportation of Debris by Running Water*. Discusses the process of suspension. Gives theoretical settler design for suspended and tractional loads. Gives details on design of sand boxes. Considers tests on Kern River No. 3 settling basin noting method of taking sediment samples with a sampler pipe and siphon action; treats laboratory method of analyzing samples and gives results of tests. The information desired was the actual path of silt through the basin, distance silt traveled, rate of deposition, and proportion of silt actually removed from the water.
90. Colorado River project presents enormous engineering problem of silt control. *Hydraulic Engin.*, vol. 4, no. 7, p. 438, illus., July 1928.
Discusses the silt content of the Colorado River (average 2 percent by weight at the Grand Canyon), its deposition in irrigation canals, or irrigated fields and in irrigation furrows, and the deleterious effect of each. Average annual cost for silt removal from canals and fields is \$2.00 per acre. Discusses the effect of Boulder Dam as a desilting basin with a 26,000,000 acre-foot capacity which will be half filled with silt in 100 yr. and the need for desilting reservoirs on tributary streams and for efficient vegetative erosion control. U. S. Dept. of Agr. Tech. Bul. 67-T, *Silt in the Colorado River and Its Relation to Irrigation*, by Samuel Fortier and Harry F. Blaney, is noted.
91. Engineering board favors Black Canyon as site for concrete dam in Colorado River. *Hydraulic Engin.*, vol. 4, no. 12, pp. 721-725, Dec. 1928.
A report of engineers favoring Black Canyon as site for dam on Colorado River. Discusses silting of proposed reservoir noting a rate of silt deposition of 137,000 acre-feet per yr. and ultimate filling in 190 yr. if no additional reservoirs are constructed upstream. Retrogression of river silt below proposed dam discussed noting the ultimate elimination of silt load.
92. Silt distribution at bifurcations on canals [letter to editor]. *Indian Engin.*, vol. 85, p. 238, illus., Apr. 27, 1929.
Comments on an article entitled *Silt Distribution at Bifurcations on Canals* (Minnas-ud-Din, K. B. Sh., 1). Suggests the use of Walker's Triform Gates at distributaries to prevent heavily silt-laden lower layers of water from entering channels.
93. Methods of protecting river banks from erosion. *Engin. and Contract.*, vol. 68, no. 5, pp. 213-215, May 1929.
Appendix to a committee report presented at the 30th annual meeting of the American Railway Engineering Association. Describes various methods of bank protection chiefly on the Mississippi and Missouri Rivers by use of brush, board, and concrete mattresses; use of mattresses and retards in railroad work; and use of riprap protection, sheet piling, and spur dikes. Discusses conditions of bank caving and erosion on the Mississippi River.
94. Ricerche sperimentali intorno al processo di chiarificazione delle acque (Experimental researches on the process of clarification of water). *L'Energia Elettrica*, pp. 1211-1220, Dec. 1929; [abstract], *Water and Water Engin.*, vol. 32, no. 275, pp. 143-144, Mar. 20, 1930.
Describes research work on the clarification of river waters by the settling of drift and sand to prevent damage to hydro-electric works.
95. How silting shortens the lives of some reservoirs. *Water Works and Sewerage*, vol. 77, no. 1, p. 30, Jan. 1930.
Deplores the lack of adequate knowledge for the accurate estimation of the life span of proposed and existing reservoirs. Stresses the economic aspects of the reservoir silting problem. Notes that old Lake Austin silted at the rate of 6 percent per annum for 8 yr. after its construction in 1893; the new Lake Austin silted at the rate of 7.3 percent per annum between 1913 and 1926. Gives data on total accumulations in, and average annual rates of silting and estimated life spans of Roosevelt, Elephant Butte, McMillan, Zuni, and Buckhorn Reservoirs.
96. Datos sobre aportaciones solidas de algunos rios espanoles (Data on the solid drift of some Spanish rivers). *Rev. de Obras Publicas*, pp. 28-31, Jan. 15, 1930; [abstract], *Water and Water Engin.*, vol. 32, no. 375, p. 145, Mar. 20, 1930.
States that article is an extract of the plan of the Spanish Service of Hydraulic Works which includes investigations regarding the sediment load of the Guadalquivir River. The study is useful in connection with problems relating to the silting of reservoirs.
97. Silting of reservoirs, causes and prevention. *Engin. and Contract.*, vol. 69, no. 2, p. 97, Feb. 1930.
Quotes an article by C. R. Knowles which appeared in *Railway Engineering and Maintenance*. The article notes that the two causes of reservoir silting are organic growth from the water and silt washed in by the water. Treats of various methods of prevention of silting and methods for silt removal from reservoirs.
98. Transports solido nei corsi d'acqua (Solid drift in streams). *Ann. dei Lav. Pubblici*, pp. 277-308, Apr. 1930; [abstract], *Water and Water Engin.*, vol. 32, no. 380, p. 401, Aug. 20, 1930.
Presents three equations, together with experimental data, which give stream gradient for water and drift.
99. La formacion de la Barra en el Puerto de San Esteban de Pravia (The formation of the bar in the harbour of San Esteban de Pravia). *Rev. de Obras Publicas*, pp. 347-349, July 1930; [abstract], *Water and Water Engin.*, vol. 32, no. 381, p. 453, Sept. 20, 1930.

- Describes the causes of bar formation in harbors and specifically the causes of bar formation in the Harbor of San Esteban, British Honduras. States that harbor works should be based on knowledge of conditions in each locality.
100. [Review of] Erosion and silting of dredged drainage ditches, by C. E. Ramser. *Water Works and Sewerage*, vol. 77, no. 9, p. 326, Sept. 1930.
Review of an article (Ramser, C. E., 4) which treats cross-sectional and hydraulic measurements of 21 dredged drainage ditches in Mississippi, Tennessee, and Iowa. Notes conditions affecting erosion and silting.
 101. New machines developed for work on irrigation ditches. *Engin. News-Rec.*, vol. 105, no. 13, pp. 501-502, illus., Sept. 25, 1930.
Discusses a ditch-cleaning machine and excavator for small ditches used by the Imperial Irrigation District, Calif. The ditch cleaner is used to remove silt and weeds from some of the 3000 miles of ditches the District cleans each year.
 102. Tamar River, Tasmania. *Commonwealth Engin.*, vol. 18, no. 3, p. 101, illus., Oct. 1, 1930.
News item on the use of a 1,300-lb. 18 ft. x 4 ft. 6 in. steel rake towed by a tug to stir up silt in the dredged channel of Tamar River, Tasmania, during ebb tide so that the tide can carry the silt out to sea. Fifteen trips are made during each ebb, each alternate trip being against the ebb. Mechanism for operating and the design of the rake are described.
 103. Sampling apparatus for Mississippi sediment investigations [abstract]. *Engin. and Contract.*, vol. 70, no. 1, pp. 13-14, Jan. 1931.
Abstract of a technical paper by T. W. Wood from the Echo (publication of Memphis Engineering District) describing briefly sampling apparatus for sediment investigations on the Mississippi River and laboratory methods of obtaining total amount of sediment.
 104. Silt costs Imperial Valley \$1,400,000 yearly. *New Reclam. Era*, vol. 22, no. 9, pp. 190-191, Sept. 1931.
Discusses the silt problems of the Imperial Valley Irrigation District caused by the heavy silt load of the Colorado River. Note is made of the silt pocket provided in the design of the Hoover Dam, the annual silt load of the Colorado, and the danger of flood to the valley. The cost of silt control in the canal systems by suction dredges, drag lines, and small bucket-line dredges is given, together with estimates of the annual quantities dredged. Dredging of the mouths of wasteways into the Salton Sea (the New and Alamo Rivers) is also very costly. Silting requires the use of current meters to determine water flow because channel depths vary from day to day. Cost to the individual farmer for maintaining his own head ditches and regrading his land is at least \$2.00 per acre per annum. The total cost due to silt is estimated as \$1,400,000 annually.
 105. Quality of the Colorado River water. *Water Works and Sewerage*, vol. 79, no. 10, p. 358, Oct. 1932.
Notes that a 5-yr. average daily load of dissolved solids carried by the Colorado River through Grand Canyon amounted to 33,100 tons; the average annual suspended load amounted to between 172,000,000 and 396,000,000 tons.
 106. The Severn barrage scheme. *Engineering*, vol. 135, pp. 394-396, illus., Apr. 7, 1933.
Gives details of construction of the Severn barrage (England). Includes a discussion of results of a model study to determine the effects of the barrage on flood periods, the amount of water flowing down Bristol Channel, navigation, siltation, and configuration of the bed of the estuary. Notes that a barrage would increase siltation in the tidal basin by 800,000 cu. yd. per annum during the first 30 yr. of operation, after which the rate of deposition would be reduced. Dredging of 600,000 cu. yd. of silt per annum would maintain navigability.
 107. Irrigation work in the Indian Bureau. *Engin. News-Rec.*, vol. 110, no. 22, pp. 712-714, June 1, 1933.
Discusses the structures and problems of the Indian Irrigation Service, noting the Wapato project in Washington, the San Carlos project in southern Arizona including Coolidge Dam, and the Hogback project near Shiprock, N. Mex. The problem of the San Carlos project is handling the silt carried down by the Gila River, most of which comes from the San Pedro River. The maximum daily deposit is 15,000 cu. yd., which is removed by special machines that dredge canals by straddling them. The dredging cost is 5 cents per yd. The solution to this silt problem is to trap the debris in the upper San Pedro River or to use an intake silt trap similar to that used at Parker, Ariz.
 108. New plans for the Mississippi. *Engin. News-Rec.*, vol. 110, no. 25, pp. 795-801, illus., June 22, 1933.
Considers plans for the Mississippi and gives a general review of the present program. In order to stabilize the stream, several cut-offs of bends are being made. Notes investigations with models to clarify problems of hydraulics of flow, detritus movement, bank protection, and regulation of the navigable channel by contraction. Points out two conclusions concerned with detritus movement: (1) transporting power of water is a function of depth, it is greatest in the thalweg and less on sloping sides of the cross section; (2) the bed load moves in small jumps, some being across the current, thus the detritus tends to move toward regions of low velocity and away from the filaments of highest velocity.
 109. New plans for the Mississippi. *Engin. News-Rec.*, vol. 110, no. 26, pp. 838-842, illus., June 29, 1933.
Describes the improvement of hydraulic efficiency of the tortuous channel of the Mississippi River by a series of artificial channels cutting off river loops. Discusses the history of natural cut-offs and their effect on bank caving and bar formation. Model studies at the U. S. Waterways Experiment Station, Vicksburg, controvert old beliefs as to the danger of cut-offs to channel regimen. Model experiments with sedimentary materials to determine the effect of erosion and deposition showed that little or no permanent effect on stages will be noted as a result of bars building below individual cut-offs. Discusses the construction program and objectives sought.
 110. New plans for the Mississippi. *Engin. News-Rec.*, vol. 111, no. 1, pp. 14-17, illus., July 6, 1933.
Describes the objectives and organization of the U. S. Waterways Experiment Station, Vicksburg, and the design, construction, appurtenances, and operation of models. This station on the Mississippi River has, in two years of operation, set criteria for the technique of river study by models. Gives a summary of the model studies.
 111. New plans for the Mississippi. *Engin. News-Rec.*, vol. 111, no. 2, pp. 41-45, illus., July 13, 1933.
Describes model experimental work performed by the U. S. Waterways Experiment Station, Vicksburg, Miss., on bed-load movement, sediment saturation and discharge determinations, erodibility of bed soils in channels, sand transportation velocities, hydraulic effect of cut-offs, and life of dredged channels at bars. Discusses model studies of bed-load movement at bends, considering current travel and velocity bed-load travel and deposition, effect of diversion channels in removing bed load from the main stream, bed-load movement at forks, and effect of dredging bars, showing that dredge cuts across bars have a temporary effect in improving the channel for the cut is soon refilled by bed-load movement. Notes that the hydraulic effect of the cut-off is a general lowering of the flow line above the cut-off and no change in elevation of the flow line below the cut-off. Describes briefly methods of taking sediment samples, laboratory methods and equipment, and methods of computing sediment discharge and transportation rates. A chart shows sediment saturation and discharge at 26

- stations where samples were taken in the sediment survey of 1930-31. Discusses model experiments on soil erodibility, giving lined flume and core-erosion results, and on sand beds to determine transportation and scouring velocities and rate of erosion.
112. Durban waterworks [abstract]. *Water and Water Engin.*, vol. 35, no. 421, pp. 462-463, July 20, 1933.
Describes operations at the Shongweni Scheme, Durban, South Africa, for year ending July 1932. Notes the effectiveness of flood-diversion works in keeping silt from the Shongweni reservoir.
113. New plans for the Mississippi. *Engin. News-Rec.*, vol. 111, no. 3, pp. 79-81, illus., July 20, 1933.
Describes model studies on Bonnet Carre railway embankment, floodways pilot channel for Boeuf floodway, and operation of the New Madrid floodway. Describes tests and result on railway embankment protection from scour and overtopping floods; soil erodibility and transportation on floodway; use of pilot channel; effect of floodway on gage heights, bankwater limits, and sediment deposition; and effects resulting from operation of the Bonnet Carre spillway.
114. New plans for the Mississippi. *Engin. News-Rec.*, vol. 111, no. 4, pp. 102-105, illus., July 27, 1933.
Discusses the creation of a self-maintaining channel in the Atchafalaya River by shortening, slope equalization, and removal of constrictions by cut-offs and agitation dredging. Describes the work of channel improvement prior to 1880 and after 1880 by the U. S. Mississippi River Commission and gives new plans.
115. New plans for the Mississippi. *Engin. News-Rec.*, vol. 111, no. 5, pp. 133-137, illus., Aug. 3, 1933.
Describes the work of increasing the shallow navigation depths between Cairo and Memphis on the Mississippi River by narrowing and stabilizing the low-water channel by means of spur dikes. Discusses the theory of river contraction and gives examples on the Mississippi and Missouri Rivers. Describes the plan of a new project.
116. New plans for the Mississippi. *Engin. News-Rec.*, vol. 111, no. 6, pp. 166-169, illus., Aug. 10, 1933.
Discusses bank revetments as used on the Mississippi River, comparing types, effectiveness, and cost. Gives a report of the underwater survey of existing revetments, including a discussion of agencies affecting revetment. Describes experiments on groins, noting their inadequacy; success of asphalt-mat experiments; and practicability of certain types of rip-rap revetment.
117. Novel river bank protection. *Construct. Methods*, vol. 15, no. 10, pp. 34-37, illus., Oct. 1933.
Describes engineering details of bank protection works on the Scioto River at Portsmouth, Ohio. Bank protection and revetment works involve the use of wood piles, a steel-sheet baffle wall, and a flexible mat of reinforced concrete.
118. Harnessing the Nile. *Civ. Engin.*, vol. 29, no. 331, pp. 5-6, Jan. 1934.
Describes the construction of dams and harnessing works on the Nile River. Includes a discussion of the Aswan Dam silt problem, commenting on a paper by H. E. Hurst read before the Royal Society of Arts, May 1933. Notes that the maximum silt carried by the Nile River is 3000 p. m. by weight, and that the Aswan Dam can be filled with water without risk of harm by silting. Gives the proportion of silt borne by the Nile River in August 1933 (Engineer's Year Book) as 1 in 666; the Mississippi River 1 in 572; the Indus River at Sukkur 1 in 163 to 1 in 198; the Vaal River 1 in 268 to 0 in 660; and the Kistna River in June, 1 in 42.
119. Los Angeles flood damage due to torrential rain. *Engin. News-Rec.*, vol. 112, no. 2, pp. 51-53, illus., Jan. 11, 1934.
Describes the flood of Dec. 31, 1933 in Los Angeles, including the report of E. C. Eaton, Chief Engineer of the Los Angeles Flood Control District. The flood carried large quantities of debris and caused considerable erosion of the previously burned-over watershed area in which the storm precipitation was concentrated. Where protective measures, such as storage dams, check dams, and channel improvement, had been previously undertaken the damage was slight, but in unprotected areas rocks as large as 5-10 tons were carried along by the flood waters. Debris was deposited in streets and homes and in the Verdugo Debris Basin. Note is made of San Gabriel dams and the bypassing of flood water around their uncompleted portions.
120. Model experiments on tidal estuaries. *Engineering*, vol. 137, no. 3564, pp. 520-521, May 4, 1934.
Discusses a lecture given by A. H. Gibson before the Royal Institution, Apr. 13, 1934, entitled *Tidal Estuaries; Forecasting by Model experiments*. Mr. Gibson points out the many debts owed by engineers to Osborne Reynolds for his method of investigating tidal estuaries by means of scale models, which was used by him with the Mersey Estuary in 1885. Discusses the construction of a river or estuary model. Notes the producing of coagulating effects of sea water in the use of model studies. Treats general use and operation of tidal models.
121. Bank-revetment on the Mississippi I, Asphalt mat revetment. *Engin. News-Rec.*, vol. 112, no. 26, pp. 825-830, June 28, 1934.
Discusses the field application stage reached in two types of revetments. Comments on a special plant for fabricating sheet-asphalt mats in the New Orleans district. Notes the fabrication of large sheets of reinforced asphalt mat on a floating barge at the site at which it is to be laid.
122. Norris Dam design modified to meet new requirements. *Engin. News-Rec.*, vol. 113, pp. 44-45, illus., July 12, 1934.
Discusses the design, location, construction, and geology of the Norris Dam on the Clinch River, Tenn. Silting in Tennessee Valley was studied in 1932, resulting in an assumption of silt flow of 0.03 percent for the Clinch River or double that of the Tennessee River at Knoxville. The annual silt load at the Norris Dam is estimated on this basis to be 1,020 acre-feet. It will take 500 yr. to silt up the 500,000 acre-foot dead storage at Norris Dam.
123. Vancouver meeting of civil engineers centers on Columbia River. *Engin. News-Rec.*, vol. 113, pp. 83-86, July 19, 1934.
Abstracts of technical papers presented before an engineering society meeting on problems of the Columbia River in Washington, its power, navigation, fish conservation, silting, dams and reservoirs. Also abstracts on Fort Peck and problems of the Central Valley, as well as problems of sewerage, irrigation, road building, and refuse disposal. A paper on silting by J. C. Stevens, including a tabulation of silt deposition in 33 large reservoirs and its effect upon the useful life of reservoirs, was given. Stevens' paper notes that the useful life of some power dams is not necessarily diminished by being filled with silt whereas a 50 percent filling of some irrigation dams would destroy the project. Notes the necessity for more complete knowledge of laws governing silt deposition and bed-load movements.
124. Two public power projects get under way in Nebraska. *Engin. News-Rec.*, vol. 113, pp. 469-472, illus., Oct. 11, 1934.
Gives details of design, construction, and cost on Loup River and Platte Valley projects in Missouri. Diversion of sand into Loup River canals is prevented by sluiceway gates with sills 5 ft. below the sills of the diversion gates. Fine loess and sand in suspension in the first waters admitted to the canal will seal voids in sand in the canal bottom and banks. Monroe, Looking Glass, and Sutherland Reservoirs are discussed. Four radial gates in the dam of Sutherland Reservoir pass silt through the dam.
125. Fort Peck Dam - an \$84,200,000 aid to navigation on

- the Missouri River. *Engin. News-Rec.*, vol. 113, pp. 693-698, illus., Nov. 29, 1934.
- News article on Fort Peck Dam noting that of the 18,080,000 acre-foot capacity of the reservoir, 366,900 acre-feet is dead storage and 225,000 acre-feet is a silt pocket sufficient to absorb all silt for 100 yr.
126. Forestry. Assoc. Chinese and Amer. *Engin., Jour.*, vol. 6, no. 3, pp. 1-2, Mar. 1935.
Describes conditions of soil erosion, transportation of sediment and its destructive deposition on rich valley soils and in streams, and floods and flood damages resulting from the denuded condition of hills and mountains at the sources of rivers. Huai River in China is cited as an example. Discusses the economic advantages of forest conservation in America and Europe.
 127. [Review of] Silt exclusion from canals, by C. C. Inglis and D. V. Joglekar. *Civ. Engin.*, vol. 5, no. 3, p. 12, Mar. 1935.
Reviews a report on an experiment (Inglis, C. C., 2) with a full-width model of the Sukkar barrage; the design of dynamically similar models in accordance with Lacey's formulas; experiments on "still pond versus open flow," with discharges equivalent to 500,000 cu. ft. per sec. and 350,000 cu. ft. per sec.; scour and silting; effect of opening undersluices to scour out silt from approach channels.
 128. Hydro-electric power plant at Cardano. *Engineer [London]*, vol. 159, no. 4133, pp. 334-336, illus., Mar. 25, 1935.
Presents details of construction of the hydro-electric plant at Cardano, in the Isarco Valley near Bolzano, in the Italian Trentino. Included is a brief description of the design of the Du-four sand removal plant which is utilized to keep sand and gravel from entering the storage basin of the plant.
 129. [Review of] Factors affecting exclusions of bed silt from canals taking off from alluvial rivers, by C. C. Inglis and D. V. Joglekar. *Civ. Engin.*, vol. 5, no. 6, p. 10, June 1935.
Discusses experiments (Inglis, C. C., 4) carried out between 1927 and 1930 at Hydro-dynamic Research Station of Bombay Public Works Dept., near Poona, to determine factors affecting movement of bed silt at offtakes from straight river; resultant theory; Gibb's theory of silt draw; silt exclusion with curved vanes; effects of divide wall.
 130. Record stream discharges feature New York floods. *Engin. News-Rec.*, vol. 115, no. 3, pp. 91-94, illus., July 18, 1935.
A news report on floods in southern and central New York and northeastern Pennsylvania, resulting from cloudbursts July 7-8, 1935. Loss of 65,000,000 tons of soil (65 tons per acre from sloping land in cultivation) was estimated in central New York, also heavy silt deposits in valleys. Rainfall and run-off data are given. A large loss in Hornell, N. Y., was reported. Cost of damage and cost of rehabilitation are given. There was a washout of silt in the collecting dam about Potters Falls Reservoir. The turbidity of reservoir water at Ithaca increased to 7,000 p.p.m. and had to be specially treated so as to deliver clear water to the system.
 131. Runoff of 34 per cent solids after denudation of watershed. *Engin. News-Rec.*, vol. 115, no. 7, p. 235, Aug. 15, 1935.
A news item on the silting of Devil's Gate Reservoir of the Los Angeles County flood control district at Pasadena, Calif., in Arroyo Seco Canyon, due to storms on the fire-denuded watershed. Silting from October 1920 to September 1934 amounted to 704 acre-feet or 1.43 percent of the total inflow of 49,174 acre-feet entering the reservoir during the 14 yr. Run-off during the storms of October 1934, after fires of July 1934 had denuded 3550 acres of the 30 sq. miles drainage area, was 480 acre-feet which brought with it 145 acre-feet of solids (34 percent of volume of runoff). Solids are estimated to have 40-45 percent voids, which on a net volume basis amount to 18 percent of the runoff.
 132. Heavy-duty excavators dig power canals on large river project. *Contractors and Engin. Monthly*, vol. 31, no. 4, pp. 1-31, Oct. 1935.
Describes heavy-duty excavators employed to dig canals of the Loup River Power Project, Nebr. Includes a description of engineering details of various works under construction. Notes the proposed construction of two desilting basins to prevent the silting of Babcock Reservoir. States that Loup River carries almost 6,500,000 tons of silt annually of which about 4,000,000 tons will be diverted into canals; without desilting, the reservoir would fill in 2 yr.
 133. Effective river control by concrete tetrahedrons. *Engin. News-Rec.*, vol. 115, pp. 470-471, illus., Oct. 3, 1935.
On the use of reinforced concrete triangular pyramical frames to form flexible tetrahedron dikes to control river channels, first used in Palo Verde Valley on the Colorado River in 1924, later used on the Santa Clara River in California in 1927 and the Belle Fourche River in Wyoming in 1930. Thirty tetrahedrons each with 16-ft. legs were used at the Santa Clara Dike. Belle Fourche Dike consists of 39 tetrahedrons, each with 9 ft., 3 in.-legs, placed 16 ft. on center extending 650 ft. across the river channel. The tetrahedron frames are joined together by 1 in. cables. Upstream face is reinforced with hog-wire fence, brush revetment, and an earth dike in front of the brush. Sandbags and riprap are used to protect the earth dike. The dike caused backfilling as high as 6 ft. in 5 yr., due to silt and debris deposited in front of the dike.
 134. Colorado River desilting at Imperial Dam. *Engin. News-Rec.*, vol. 115, pp. 538-541, illus., Oct. 17, 1935.
Discusses the design of the Imperial Dam across the Colorado River and of the headworks of the All-American Canal, particularly the desilting works. Gives design in detail and explains necessity for desilting, the operation of the desilting basins, the use of the roller gates, the Arizona headgates, the surplus water sluiceway, and the underdrains provided in the structure.
 135. Head erosion at its worst. *Soil Conserv.*, vol. 1, no. 5, pp. 14-15, illus., Dec. 1935.
Describes the conditions of formation of a gully 1,500 ft. long, 30-120 ft. deep, and 75-120 ft. wide during six days in March 1927 in the Gardena farming district, Wash. Water flowing into Pine Creek was estimated to contain more than 18 percent silt by weight, and thousands of tons of silt were carried into the Columbia River.
 136. Silt, not water; often fills lakes and reservoirs. *Amer. City*, vol. 51, p. 9, Feb. 1936.
Notes results of studies by the U. S. Soil Conservation Service relative to the effect of erosion on water supplies. Brief data are given on rates of silting in the Rogers Reservoir, Tex., Lake Waco, Tex., Spartanburg Reservoir, S. C., Great Morgan Falls Reservoir, Ga., and San Carlos Reservoir, Ariz.
 137. Severe erosion in lateral streams checked by the Erie. *Railway Age*, vol. 100, no. 5, pp. 206-209, illus., Feb. 1, 1936.
Describes the effectiveness of measures taken to produce non-eroding flow by the construction of check dams on spillings and by clearing and widening the channels in a number of lateral streams in southern New York. The effectiveness of the control measures in keeping deposits of large quantities of gravel, rock, silt, and debris from the Erie Railroad during the flood of July 6-8, 1935 is described.
 138. TVA report goes to Congress. *Engin. News-Rec.*, vol. 116, no. 14, pp. 504-505, Apr. 2, 1936.
A news item on work done and proposed by TVA. Includes one paragraph on a land program to prevent reservoir and river silting, noting Hales Bar Dam as one which has silted one-third in 23 yr.

139. Silt measurements during Potomac River flood. Soil Conserv., vol. 1, no. 10, p. 14, May 1936.
Notes that a sample of water collected Mar. 19, 1936 during the height of the Potomac River flood, 5 miles above Washington, showed a silt content of more than 0.5 percent, indicating that the Potomac River was, at that stage, carrying 2,000 cu. ft. of silt per sec. down to the sea.
140. A reservoir silting case. Engin. News-Rec., vol. 116, p. 695, May 14, 1936.
Notes the silting of Neubert Springs millpond 7 miles south of Knoxville, Tenn., after the wash-out of a 15-ft. earth dam on Mar. 24, 1936. From 1921, when the dam was built, to its failure in 1936 (15 yr.) the 2 1/2-acre pond silted 85 percent full to within 2 ft. of the pond level at the rate of 1 acre-foot per yr. The silt represents a little less than 1/2 in. of soil from the 1100-acre drainage area. Remains of an older dam upstream caught a large part of the bed load leaving only lighter material to settle in the lake.
141. Desilting works for Loup project. Engin. News-Rec., vol. 117, pp. 574-576, illus., Oct. 22, 1936.
Describes the engineering features of the Loup River desilting works which will remove an estimated 10,000 tons of silt a day and keep the 35-mile power canal from being clogged. Works consist of a long diversion weir, river control gates, an intake structure, and a long stilling basin. Dredge pumps mounted on a traveling bridge over the stilling basin will remove silt and water or sludge and discharge it into a channel paralleling the basin for ultimate discharge into the river.
142. T. V. A. plants trees, builds check dams, in move to protect Norris Dam from silting. Soil Conserv., vol. 2, no. 6, pp. 114-115, 130, illus., Dec. 1936.
Describes the comprehensive program of the Tennessee Valley Authority, to prevent silting of Norris Dam. Describes the control of excessive erosion, accomplished by engineering and vegetative measures on the watershed.
143. [Review of] Rivers, hydraulics, by C. Keutner. Civ. Engin., vol. 7, no. 1, p. 14, Jan. 1937.
Review of article by C. Keutner (Bautechnik, vol. 14, no. 6, Feb. 4, 1936, pp. 98-108) on the Munich Hydraulic Laboratory tests of straight and winding courses of silt-carrying rivers having stable normal beds. The problem was to determine flood-stage behavior of Hwangho River in China and to determine the effect of distance between levees on flood regime of the river. Considers silt analysis.
144. Dredging a reservoir. Commonwealth Engin., vol. 24, no. 6, p. 220, illus., Jan. 1, 1937.
Describes the removal of silt by dredging from a reservoir of the Rand Mines, South Africa. The 100-acre reservoir of 30-35 ft. original depth silted until the depth was only 14 ft. Capacity decreased to 23,000 cu. ft. Using a clamshell dredge, 245,740 cu. yd. of silt were removed in 13 months, increasing the water capacity by 41,775,800 gal. Cost was 4.80d. per cu. yd. or 2s. 4d. per 1,000 gal. gain in capacity.
145. Silt in water works reservoirs [letters to editor]. Water Works Engin., vol. 90, no. 1, pp. 45-46, Jan. 6, 1937.
Letters by superintendents and managers of municipal water works. Silting conditions in reservoirs at Columbus, Ga., Elmira, N. Y., Springfield, Ill., Shreveport, La., and Wilmington, Del., and methods of prevention are discussed. Mention is also made of conditions at New Bedford, Mass., Winona, Minn., and Flint, Mich. Silt as a source of bad odor and taste in drinking water is noted as well as the reduction of storage capacity. Silt control by tree planting, grass and crop planting, and riprapping, and use of small dams of sheet steel piling to prevent sedimentation in reservoirs are described in general.
146. Bank protection on the Mississippi River. Engineering, vol. 143, pp. 249-252, illus., Mar. 5, 1937.
Relates to bank protection on the Mississippi River. Discusses various features of river, rainfall, geological history of alluvial valley, character of banks and bends, bank-caving factors effecting caving and methods of bank protection. Describes study on effectiveness of reinforced asphalt mattresses for bank protection works.
147. The silting of reservoirs. Engineering, vol. 144, no. 3737, pp. 233-234, Aug. 27, 1937.
An editorial on reservoir silting problems including a discussion of The Passage of Turbid Water through Lake Mead (Grover, N. C., 12), and of a report by A. D. Lewis to the Second Congress on Large Dams (Washington, D. C., 1936) on silting of South African reservoirs. The relation of laboratory and model studies to field conditions is noted. The need for further study and research is stressed.
148. [Review of] Development of the lower Colorado River, by O. Laugaard. Civ. Engin., vol. 8, no. 4, pp. 286-287, Apr. 1938.
A review of a paper which traces the course of development of the lower Colorado River since the construction of the Laguna Dam. Describes Boulder, Parker, and Imperial Dams and All-American Canal projects. Discusses the silt problem with reference to the possibility of bed degradation below the dams.
149. Study silting effect on hydro plants. Elect. World, vol. 109, p. 1704, May 21, 1938.
Notes the aims of the sediment-load testing laboratory of the U. S. Department of Agriculture on Rocky Creek, Iredell County, N. C.
150. [Review of] The regime of the Rivers Euphrates and Tigris, by M. G. Ionides. Engineering, vol. 145, p. 604, May 27, 1938.
Reviews the book (Ionides, M. G., 2). Describes river basins; climate and rainfall; river gauges, records, river cross-sections, and water measurements; history of Hindia Barrage; and silt conditions and instability of gauging sites. Table gives estimated silt content of both rivers, month by month, near Baghdad, and Ramandi, respectively.
151. Silt-eliminating flume for high silt content water. Pub. Works, vol. 69, no. 6, pp. 15-16, illus., June 1938.
Describes the silt removal works of the Loup River Public Power District project (commonly known as Columbus Project) near Columbus, Nebr., consisting of a low control weir across the Loup River to permit the diversion of water into a settling basin and canals to carry water from the settling basin to the power house. The weir is designed to present the least possible obstruction to the natural flow in order to prevent the bed load from drifting into the power canal. The settling basin, 200 ft. wide, 10,000 ft. long, 16 ft. deep, will retain 75 percent of suspended silt and all the bed load. Water velocity in the basin is .75 ft. per sec. or one-third the velocity in the main canal. The settling basin is to be dredged by a floating 28-in. suction dredge discharging 1,100 cu. yd. of silt per hr. Concrete and metal sludge flumes are employed to distribute dredged material along the north bank between the basin and the river and will eventually change the stream course to the opposite bank to eliminate silt.
152. State Rivers and Water Supply Commission of Victoria, Australia [abstract]. Water and Water Engin., vol. 40, no. 496, pp. 396-399, July 1938.
A report of the State Rivers and Water Supply Commission, Victoria, Australia, describing the various irrigation and water supply systems and flood protection districts under the jurisdiction of the Commission. Notes plans of Commission for the conservation of river resources by means of erosion control measures on watersheds. Reports that silt deposits reduced the capacity of Laanecoorie Reservoir from 14,000 acre-feet to 6,650 acre-feet since its completion in 1892.
153. Three concrete arch dams for mining debris control. West. Construct. News, vol. 13, no. 7, pp. 262-263, illus., July 1938.

- Describes construction operations by the Corps of Engineers, U. S. Army, on three concrete arch dams for mining-debris control on the American and Yuba Rivers, Calif. Structures will provide reservoirs which will restrain the debris from mining operations and desilt the flow of the river for the benefit of navigation and water supply. Estimates indicate that 1,555,000,000 cu. yd. of debris from hydraulic mining operations were transported down California streams and into the upper San Francisco Bay from 1849 to 1914. Notes that the Yuba River low water level increased a vertical distance of 19 ft. from 1849 to 1905 by deposition of mining debris. Discusses legal actions involved in mining operations and describes the construction program.
154. [Review of] Effect of discharge of crude sewage into the estuary of the Mersey on the amount and hardness of the deposit in the estuary. *Inst. Munic. and County Engin., Jour.*, vol. 65, no. 5, pp. 346-348, Aug. 16, 1938.
Notes that the paper (Gt. Brit. Dept. Sci. and Indus. Res., Water Pollut. Res. Tech. Paper no. 7) presents results of investigations on the main sources of mud in the estuary, the character of suspended and deposited mud in the estuary, the erodibility of Mersey mud, and the effect of deposits on the capacity of the stream.
 155. Reviewing the official report on the record Los Angeles flood of March 2. *West. Construct. News*, vol. 13, no. 9, pp. 328-330, Sept. 1938.
Reviews the report of the Los Angeles County Flood Control District covering rainfall, runoff, and debris movement of the Mar. 2, 1938 flood. Includes general information on silting behind San Gabriel No. 1, San Gabriel No. 2, Pacoima, Santa Anita, Sawpit, and Tujunga Dams. Debris basins impounded 541,000 cu. yd. of debris which otherwise would have been deposited in residential areas.
 156. Flood prevention and other hydraulic problems in China. *Engineer [London]*, vol. 156, no. 4313, pp. 278-280, illus., Sept. 9, 1938; also in *Assoc. Chinese and Amer. Engin., Jour.*, vol. 19, no. 6, pp. 385-398, Nov./Dec. 1938.
Discusses flood prevention, irrigation, and river and canal navigation in China, including the floods of 1931 and 1935 and their social and economic effects. Describes China's river systems and notes that the silt load in some main feeders of the Yellow River is occasionally 40-50 percent by weight with the average load for the lower river about 10 percent. Estimates that 1,200,000,000 tons of silt on the average is annually transported by the Yellow River to the sea and about 43,000,000 cu. yd. of silt is deposited annually in the channel, raising the bed 4-5 ft. each century. Discusses Yellow River migrations and notes that at velocities below 3 ft. per sec. sedimentation is rapid. Describes ancient earthen dikes with kaoliang reinforcement and new stone dikes. Notes the impracticability of dredging the Yellow River. Discusses the Yangtze River, noting the volume of solid matter in suspension carried past Hankow annually as 5,000,000 cu. ft. or 2500 times that transported past London Bridge. Floods on Yangtze tributaries are caused by torrential rains which "loess" and choke the rivers. Describes canals and possibilities for detention reservoirs in China which, because of the silt load of rivers, would fill up very rapidly.
 157. More water and power, less silt for San Carlos project, main Buttes Dam objectives. *Ariz. Prod.*, vol. 17, no. 13, pp. 1, 23, Sept. 15, 1938.
Discusses the proposed Buttes Dam of the San Carlos irrigation project, noting cost, construction, and effect on silting of canals, laterals, and ditches of the project. The dam is to be located on the Gila River 25 miles east of Florence, 4 miles above Ashurst-Hayden Diversion Dam, and 61 miles below Coolidge Dam. Between the two dams is the confluence of the muddy, flashy San Pedro and Gila Rivers. The San Pedro sometimes carries as much as 25 percent silt and carries 15,000 cu. yds. of silt daily into canals and laterals of the project, adding at least \$1.00 an acre annual maintenance cost for silt removal. Buttes Dam will offer a retention basin for silt for at least 75 yr. before filling up.
 158. [Review of] Placer mining on the Rogue River, Oregon, in its relation to the fish and fishing in that stream, by Henry Baldwin Ward. *Engin. and Mining Jour.*, vol. 139, no. 10, p. 28, Oct. 1938.
Summarizes results of observations (Ward, H. B., 2) on the effect of placer operations upon fish and fish life in the Rogue River system.
 159. Fires and fishing. *Mo. Conserv.*, vol. 1, no. 2, p. 3, illus., Nov. 1938.
Briefly summarizes results of observations by E. Atwood of the Clark National Forest, Mo., on the effect of silt in the St. Francois and Black Rivers on the fish population of the streams. Notes correlation between species of fish caught and turbidity of stream.
 160. River Nene improvement works. *Engineer [London]*, vol. 166, no. 4326, pp. 641-646, illus., Dec. 9, 1938.
Presents a description of river improvement work in progress on the River Nene in the vicinity of Peterborough, England. Conditions of bed and banks of the stream at Wisbech are briefly described. Details of bank protection and dredging operations are given.
 161. Rates of debris collection by check and storage dams. *Engin. News-Rec.*, vol. 122, no. 1, p. 16, Jan. 5, 1939.
Comments on the efficiency of debris basins in Southern California during the storm of Mar. 2, 1938. The average capacity of 15 flood-control reservoirs was reduced 12 1/2 percent by debris accumulations, nine debris basins contained 541,000 cu. yd. of material after the 1938 storm. The flood of Jan. 1, 1934 left 659,000 cu. yd. of debris in the streets of the La Crescenta-Montrose district. The average rate of erosion for 10.01 sq. miles of watershed above the debris basins was 60,000 cu. yd. per sq. mile, and above storage reservoirs, 51,000 cu. yd. per sq. mile. The estimated debris content ranged up to 30 percent of the total volume of the flood during the 24-hr. period of maximum flood. Summarized data on the silting of Los Angeles County reservoirs after the floods of March 2, 1938, are given.
 162. Soil erosion and conservation in the United States. *Engineering*, vol. 147, no. 3809, pp. 31-33, illus., Jan. 13, 1939.
Gives a general discussion of soil erosion and conservation in the United States. Gives causes and effects of gully formation and notes that 400,000,000 tons of soil are carried annually into the Gulf of Mexico by the Mississippi River. Silting behind the Elephant Butte Dam reduced the capacity 13 percent in 20 yr. Zuni Reservoir, N. Mex. lost 70 percent of capacity in 22 yr. Reservoir and irrigation works on the Boise River in Idaho are being silted up despite efforts to keep accumulations down. Refers to The Silting of Reservoirs in *Engineering* of Aug. 27, 1937, p. 233. Notes filling up of Lake Como at Hokah, Houston County, Minn. in 10 yr. as a result of the denudation of upstream areas. Silting of the lake killed fish. Discusses economic effects of reservoir silting, means of reducing the rate of loss of storage capacity in reservoirs by detention of silt in headwater and valley areas by engineering works and vegetative screens, permanent reduction of silt content in contributing streams by erosion control practices in watershed areas, relation of erosion control to flood control, and agricultural methods of reclaiming and conserving lands.
 163. All-American Canal seasoning operations. *Reclam. Era*, vol. 29, no. 4, p. 77, illus., Apr. 1939.
Describes operations in progress during February 1939 at Imperial Dam and the All-American Canal. Heavy releases at Boulder Dam carrying heavy silt loads were passed through a desilting basin at Imperial Dam and throughout the first 22 miles of the All-American Canal. Silty water was desired to

- seal the sides and bottom of the canal and to test the walls and floors enclosing the basins. Briefly describes desilting works which will remove 70,000 tons of silt daily.
164. Experiments with a scale model of the Edouard Herriot dock at Lyon. Engineer [London], vol. 167, no. 4345, pp. 490-492, illus., Apr. 21, 1939. Presents an account of experiments performed in the research laboratory of the hydraulic engineer school at Grenoble, France, with regard to the accretion of silt at the entrance to the Edouard Herriot dock at Lyon. Discusses the hydrology of the Rhone at Lyon and the granular composition of its bed material, the position of the dock entrance, and the arrangement of the scale model. Gives results of tests.
165. The All-American Canal II. Engineer [London], vol. 167, no. 4353, pp. 728-733, illus., June 16, 1939. Describes engineering features of the All-American Canal system and appurtenant works. A detailed description of the desilting works is given.
166. Planting willows along ditches to prevent erosion. Reclam. Era, vol. 29, no. 8, pp. 221-222, illus., Aug. 1939. Describes proper methods of cutting and planting willows along ditches to prevent erosion. The effectiveness of willow planting along ditches of the North Platte project and in the Pathfinder Irrigation District is noted.
167. Mississippi River cutoffs effective. Engin. News-Rec., vol. 123, no. 5, pp. 138-142, illus., Aug. 3, 1939. Discusses the effectiveness of slope regulation by cut-offs and of controlled scour by training dikes in the Mississippi River between Vicksburg and Natchez; the progress of cut-off operations; river slope adjustment; improvements in reaches between bends; and the use of training dikes and correcting dredging.
168. Vane-wheel eroder for Indian Rivers. Engineering, vol. 148, no. 3842, pp. 264-265, illus., Sept. 1, 1939. Describes the design of apparatus which employs the hydraulic jet-erosion process of maintaining channels of small waterways.
169. Old rails hold fill slopes. Engin. News-Rec., vol. 122, no. 23, p. 770, illus., June 8, 1939. Describes the method employed by the Southern Pacific Co. in which old rails and heavy screen are employed to form protective jetties and to anchor bank revetment.
170. The Yellow River. Engineer [London], vol. 169, no. 4401, p. 455, May 17, 1940. Notes that mud and silt now passing from the Hwai River into the Yangtze River will cause flooding of the lower Yangtze Valley and will effect changes in the courses of both the Yangtze and Yellow Rivers.
171. Silting of reservoirs. Pub. Mangt., vol. 21, p. 251, Aug. 1939; [abstract], Amer. Water Works Assoc., Jour., vol. 32, no. 6, p. 1052, June 1940. Notes that municipal reservoirs in North Carolina are losing an average of 1 percent of original capacity annually. Erosion control on the High Point watershed reduced silting in the city reservoir by 50 percent in 4 yr.
172. A quarter century of aqueduct maintenance. Engin. News-Rec., vol. 124, no. 23, pp. 54-57, illus., June 6, 1940. Deals with the history, operation, and maintenance of the Los Angeles Aqueduct. Briefly notes improvements now under construction to permit the use of a drag line to remove deposits from the aqueduct.
173. Ancient harbors II. Engineer [London], vol. 170, no. 4427, pp. 316-317, illus., Nov. 15, 1940. Presents a description of several ancient Grecian and Roman harbors. Notes that silting drove the Romans from the harbor at Antium and from the Tiber, and turned the magnificent harbor at Ostia into a failure.
174. Calculation of terminal speeds. Engineering, vol. 150, no. 3908, pp. 441-444, Dec. 6, 1940. Deals with the calculation of terminal speeds attained by a body falling freely through an unrestricted volume of viscous fluid. Describes a method devised by Messrs. Bosanquet, Carey, and Stairmand of the research staff of Imperial Chemical Industries, Ltd., at Billingham-on-Tees. The principle used is related to the transition region between the Stokes and Newton regions. An estimate is made of a free-falling or terminal speed with the idea that Stokes' law is valid. This value is corrected for the divergence of true resistance from that which is obtained by Stokes' law. Refers to an article (Challey, H., 16) regarding applications of the laws of fluid motion governing the terminal velocity.
175. Great Ouse flood protection [abstract]. Engineer [London], vol. 171, no. 4443, pp. 159-161, illus.; no. 4444, pp. 174-176, illus., Mar. 7-14, 1941. Deals with conditions ruling the problem of draining the Fens and analyzes critically various schemes propounded from time to time for bringing about the improvement of the conditions which cause the overtopping or breaking down of the banks of the Great Ouse and flooding in the Fenlands. Includes a discussion on the effects of improvements upon silting in the river.
176. The Lacey theory of river stability. Engineering, vol. 151, pp. 404-405, May 23, 1941. Discusses Gerald Lacey's paper entitled A Regime Flow in Incoherent Alluvium (Lacey, G., 10). Gives Lacey's regime formula, independent of silt grade. Comments on formulas used by Manning and Kennedy.
177. Removing reservoir silt by sluicing operations. Engin. News-Rec., vol. 127, no. 1, p. 56, illus., July 3, 1941. Describes desilting operations at the Upper San Fernando Reservoir, Calif. The reservoir's original capacity of 1977 acre-feet was reduced to about 1500 acre-feet by silt deposits, a 24 percent decrease. An estimated total of 20,000 cu. yd. of sediment was removed by sluicing. The place for disposal was at the extreme upper end of the Lower San Fernando Reservoir where a debris basin was constructed. Notes that storm channels have been built to prevent the entry of heavy debris-laden flows into both the upper and lower reservoirs.
178. Keeping debris out of reservoirs by soil erosion control. Engin. News-Rec., vol. 128, no. 25, p. 82, illus., June 18, 1942. Outlines methods used to prevent the silting of East Bay Municipal Utility District reservoirs in California. Protective works consist of non-clogging inlets and protective aprons for road culverts, stream-bank protection, tree planting, interceptor ditches and flumes around road cuts, and check dams.
179. Apparatus for particle size analysis. Engineering, vol. 154, no. 3997, pp. 141-142, illus.; no. 3999, pp. 181-182, illus.; no. 4001, pp. 221-223, illus.; no. 4002, pp. 241-242, illus., Aug. 21, Sept. 4, 18, 25, 1942. Describes a new form of photographic sedimentation apparatus developed by the research staff of the Imperial Chemical Industries, Ltd. at Billingham-on-Tees and compares results of performance tests with other types of apparatus developed by various workers. This report is the substance of a number of internal reports of which Mr. C. J. Stairmand and Mr. W. F. Carey are the principal authors. Tests show that the photo-sedimentation apparatus gave correct absolute values of size grading. The apparatus is regarded as a standard of particle sizing within the range of 2 microns to 100 microns; it photographs the tracks of particles as they fall under gravitational attraction into a stagnant liquid. Stokes' law and the length of the track of each particle are used to calculate the diameter. Describes various other apparatus for particle-size analysis and notes that the turbidimeter may have a great promise for future development. An error has been noted (Fairs, G. L., 1).
180. High silt content of Colorado River. Engin. News-Rec., vol. 130, pp. 108-109, Apr. 8, 1943.

- Discusses the high silt content of the Colorado River in records covering 16 yr. Gives data on suspended load and dissolved matter. Comments on Boulder Dam, Lake Mead, and Parker Reservoir.
181. Reading's silt basins protect streams and save valuable coal. *Coal Age*, vol. 48, pp. 64-67, illus., May 1943.
Describes the use of silting basins to protect the silting of streams by fine sizes of anthracite coal and to save coal.
 182. Santa Barbara will double water storage by raising dam. *West. City*, vol. 23, no. 3, p. 28, Mar. 1947; [abstract], *Amer. Water Works Assoc., Jour.*, vol. 39, no. 8, p. 816, Aug. 1947.
Discusses plans for raising the dam of the Gibraltar Reservoir on Santa Ynez River to increase the water supply. The reservoir, built 26 yr. ago, has lost one-half of its capacity because of silting, while the population has doubled.
 183. River mud clearance by jet engine. *Engineer* [London], vol. 184, no. 4778, p. 182, illus., Aug. 22, 1947.
Discusses briefly the use of a jet aircraft engine mounted on a barge for cleaning mud from the bed of the River Thames. High pressures are created and it is hoped to disintegrate the mud in such a manner that the tide will wash it away.
 184. Dredging large sand deposit from power plant forebay. *Engin. News-Rec.*, vol. 139, no. 24, pp. 122-123, Dec. 1947.
Discusses the removal of almost 1,000,000 cu. yd. of volcanic sand from Lake Roslyn, Oreg., by an electric dredge.
 185. Pennsylvania cleans its worst river. *Engin. News-Rec.*, vol. 142, no. 10, pp. 21-24, Mar. 10, 1949.
Comments on an over-all desilting project for the Schuylkill River. Notes that deposits of coal dust (culm), rock, and silt are the big problem. Considers impounding basins, work at Kernsville Dam, and dredging.
 186. Can sediment studies extend reservoir life? *Civ. Engin.*, vol. 19, no. 5, pp. 328-329, illus., May 1949.
Discusses various papers given at the Hydraulics Division of the A.S.C.E. meeting in Oklahoma City, Okla., during April 1949. The reports deal with the measurement of sediment in rivers, reservoirs, and harbors. (Thomas, C. W. 1; Caldwell, J. M., 1; Gottschalk, L. C. 14; Einstein, H. A., 12.)

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DISPERSION AND FLOCCULATION

Acheson, E. G., 1; Anters, E., 4; Barton, E. C., 1; Bliss, W. J. A., 1; Boswell, P. G. H., 2; Brewer, 1, 2; Bull, A. W., 1; Camp, T. R., 2; Comber, N. M., 1, 2; Davis, R. O. E., 4; Donald, M. B., 1; Egoft, C. B., 1; Einstein, H. A., 3; Forshey, C. G., 2; Fortier, S., 2, 3; Free, E. E., 2; Fuertes, J. H., 1; Gillespie, C. G., 1; Graham, H. C., 1; Grover, N. C., 12; Grunsky, C. E., 5; Hazen, A., 1, 2; Hering, R., 1; Hjulström, F., 1; Hooker, E. H., 1; Humphreys, A. A., 1; Hunt, T. S., 1; Irwin, W. H., 1; Johnston, W. A., 1; Kelley, W. P., 1; Kermack, W. O., 1; Kiersted, W., 1, 2; Kindle, E. M., 1; Ladd, G. E., 1; Laird, F. W., 1; Lane, E. W., 4; Lewis, A. D., 2; Lyon, T. L., 1; Mitchell, B. T., 1; Nutting, P. G., 1; Sayles, R. W., 1; Skey, W., 1; Slade, J. J., 2; Straub, L. G., 6; Tchen, C. M., 1; Townsend, C. M., 4; Twenhofel, W. H., 1; U. S. Engineer Dept., 92; U. S. Geological Survey, 1; U. S. Waterways Experiment Station, Vicksburg, Miss., 15; Van Orstrand, C. E., 2; Vernon-Harcourt, L. F., 9; Watson, J. W., 1; Wells, R. C., 1; Willis, B., 1; Young, W. R., 1; Anonymous, 120

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Beeman, N., 1; Boswell, P. G. H., 2; Brewer, W. H., 1, 2; Chatley, H., 6; Comber, N. M., 1, 2; Dreveskracht, L. R., 1; Durham, W., 1; Fraser, H. J., 1; Free, E. E., 2; Fuertes, J. H., 1; Graham, H. C., 1; Kermack, W. O., 1; Nutting, P. G., 1; Skey, W., 1

Suspended matter in streams, reservoirs and estuaries

Barton, E. C., 1; Blaauw, G., 1; Breazeale, J. F., 1; Brush, W. W., 1; Humphreys, A. A., 1

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Control of deposition

Burnet, G., 1; Dappert, J. W., 1; Dean, S., 2, 3; Finley, G. B., 1; Harman, J. A., 1, 3; Jones, L. A., 1; Lilly, A. J., 1; Lynde, H. M., 1; Ramser, C. E., 4, 5, 6; Robertson, L. E., 1; Smith, F. R., 1; Smith, G. P., 1, 2; Towl, R. N., 2, 3, 4, 5, 6; U. S. Engineer Dept., 33, 41, Anonymous, 65

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Baker, S. K., 1; Bartel, F. O., 1; Burnet, G., 1; Dappert, J. W., 1; Dean, S., 2, 3; Hupp, S. C., 1;

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Hoag, W. R., 1; Lilly, A. J., 1; Lynde, H. M., 1; Morgan, A. E., 1; Ramser, C. E., 1, 2, 4, 5, 6, 7, 8, 9; Schlick, W. J., 1; Sheppard, C. A., 1; Smith, F. R., 1; Towl, R. N., 2, 3; Trullinger, R. W., 1; U. S. Engineer Dept., 41, 77; U. S. Forest Service, 2; Anonymous, 65, 100

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Lilly, A. J., 1

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Baker, B., 1; Bengal Agricultural Chemist, 1; Bennett, H. H., 1; Berger, L. G. den, 1; Bradford, W., 1; Braine, C. D. H., 1; Breazeale, J. F., 1; Bridgeman, A. S., 1; Brown, C. B., 6; Brown, L., 1; Brown, M. H., 1; Buck, E. C., 1, 2, 3; Burma Dept. of Agriculture, 1, 2; Clemson, T. G., 1; Collingwood, C. B., 1, 2; Culbertson, G., 1; Cushing, F. H., 1; Custis, G. W. P., 1; Dana, S. L., 1; David, T. W. E., 1; Davis, A. P., 1, 9; Dorsey, E. B., 1; Dunklee, D. E., 1; Du Toit, P. J., 1; Dwight, T., 1; Ehrenberg, M., 1; Faris, O. A., 1; Fermor L. L., 1; Finley, W. L., 1; Fiock, L. R., 1; Fippin, E. O., 1; Fisher, C. A., 1; Fitzpatrick, J. C., 1; Follett, W. W., 2; Fontaine, E., 1; Foote, A. D., 1, 2; Forbes, R. H., 2, 3, 4; Fortier, S., 3; Gardner, J. L., 1; Gibling, M. T., 2; Goss, A., 1; Gottschalk, L. C., 4; Grant, K. C., 1; Häntzschel, W., 1; Harper, H. J., 7; Harrold, L. L., 1; Headden, W. P., 2; Herapath, 1; Hoon, R. C., 1; Hough, J. L., 3; India, Board of Agriculture and Animal Husbandry, Committee on Soil Amelioration, 1; India, Central Board of Irrigation, 3; Jones, H. F., 1; Juritz, C. F., 1; Kanthack, F. E., 2; Kucinski, K. J., 1; Lacey, J. M., 6; Leighton, M. O., 1; L'Hommedieu, E., 1; Lippincott, J. B., 3, 4; Luiggi, L., 1; McGee, W. J., 4; McGeorge, W. T., 1; Majumdar, S. C., 1; Matthes, G. H., 3; Means, T. H., 1; Mitra, A. N., 1; Mosseri, 1; Müntz, A., 3; New Hampshire Flood Reconstruction Council, 1; Newell, F. H., 7, 9; Newhouse, F., 1; Niccoli, V., 1; Nichols, G., 1; Nikolitch, M., 1; Parker, P. A. M., 1; Pearson, A. N., 1; Redway, J. W., 1; Roberts, B. S., 1; Shaw, A. M., 1; Smith, W. D., 1; Stall, J. B., 1; Stevens, J. C., 5; Stockford, J. A., 1; Stone, C. H., 1; Subrahmanyam, V., 1; Tait, C. E., 1; Tamhane, V. A., 1, 2; Taylor, E. M., 1; Todd, O. J., 3, 7, 10; Torrance, W., 1; U. S. Engineer Dept., 25, 30, 45, 61; Voelker, J. A., 1; Wallace, R., 1; Warren, G. M., 1; Whitefield, A. F., 1; Whitney, P., 1; Willcocks, W., 1, 4; Willey, D. A., 2; Wilson, C. M., 1; Wilson, G., 1; Wilson, H. M., 3; Anonymous, 5, 45, 50

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Improvement

Allen, C. R., 2; Allison, J. C., 3; American Society of Civil Engineers, 1; American Society

of Civil Engineers, Special Committee on Floods and Flood Prevention, 1; Arroyo, S., 1; Beach, L. H., 1; Brown, L., 1; Brown, L. W., 1; California Debris Commission, 2; Carson, W. W., 1; Classen, A. G., 1; Claxton, P., 8; Clyde, G. D., 1; Collingwood, F., 1; Combs, T. C., 1; Crowell, J. F., 1; Cruise, R. E., 1; Dabney, A. L., 2; Dobson, G. C., 2; Eads, J. B., 2, 3, 7; Eakin, H. M., 6, 7; Eaton, E. C., 1; Eliassen, S., 4; Elliott, D. O., 1; Engels, H., 2; Etcheverry, B. A., 3; Ferguson, H. B., 3; Freeman, J. R., 2, 4, 6; Goodrich, R. D., 1; Grunsky, C. E., 2, 3, 6; Haas, W. H., 3; Higgins, G., 1; Hintgen, L. N., 1; Howard, D. S., 1, 2; Humphreys, A. A., 1; Huntsman, B. W., 1; Inglis, C. C., 41, 69; Jackson, T. H., 1, 2; Joglekar, D. V., 4; Johnson, J. B., 1, 2; Kao, C. Y., 4, 6; Kelly, W., 1; Khanna, R. K., 6; Klorer, J., 1; Knowles, M., 1; Lane, E. W., 1, 11, 19; Lawson, L. M., 5; League of Nations, 1; Lennie, A. B., 1; Lukens, H. M., 1; McCaffery, A. H., 1; Matthes, G. H., 3; Matthias, N. A., 1; Merrill, W. E., 1; Munns, E. N., 1; Murray, E. B., 1; Nebraska State Planning Board, 1, 2, 3, 4, 5, 6, 7; Ockerson, J. A., 3, 6; Olivecrona, G. W., 1; Olmstead, F. H., 1; Parkhurst, V. R., 1; Pennsylvania State Planning Board, 1; Pennsylvania Water Supply Commission, 1; Pickels, G. W., 1, 2; Powell, J. W., 1; Pyeritz, H. W., 1, 2; Rizer, R. L., 1; Robbins, A. G., 1; Roberts, T. P., 1; Roberts, W. J., 1; Robinson, W. G., 1; Rossiter, E. A., 1; Schulz, E. H., 6; Scott, W. A., 1; Senour, C., 2; Shaw, A. M., 2, 3, 4; Shepard, W., 1; Silcox, F. A., 2; Smith, W. D., 1; Sonderegger, A. L., 1; Springer, J. F., 1; Starling, W., 5; Szilary, J., 1; Todd, O. J., 1, 9, 10; Towl, R. N., 5; Townsend, C. M., 1; U. S. Engineer Dept., 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 47, 48, 49, 50, 51, 52, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 77, 78, 79, 81, 82, 83, 84, 85, 86, 87, 88, 89, 93, 94; U. S. Mississippi River Commission, 9, 10; Vernon-Harcourt, L. F., 1; Vogel, H. D., 1; West, C. R., 1; Wheeler, W. H., 1; Winsor, L. M., 1, 2, 3, 4; Woolsey, T. S., Jr., 1; Yellow River Commission, 1; Yen, C. H., 1; Anonymous, 15, 23, 37, 38, 76, 87, 156, 175

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Deposition on

Allison, J. C., 4; American Society of Civil Engineers, Special Committee on Floods and Flood Prevention, 1; Bailey, R. W., 1; Barber, J. W., 1; Barrows, H. H., 1; Bates, C. G., 4; Bennett, H. H., 3, 6; Black, R. F., 1; Bowie, A. J., 1; Broughton, W. A., 1; Brown, A., 2, 4, 6, 12; Brown, L. W., 1; Brown, M. H., 1; Bryan, K., 2, 17; Buckley, R. B., 4; Chi, C., 1; Clark, W. C., 1; Collie, G. L., 1; Cooper, W. S., 1; Culbertson, G., 1; Cumings, E. R., 1; Davis, A. P., 10; Eakin, H. M., 6; Evans, O. F., 3, 4, 5; Fenneman, N. M., 1; Fisk, H. N., 1, 2, 3; Freeman, J. R., 2; Frye, J. C., 1; Fuller, M. L., 1; Gilbert, G. K., 10; Glenn, L. C., 1, 3; Goodrich, R. D., 1; Grunsky, C. E., 2, 6; Gustafson, A. F., 2; Haas, W. H., 1; Hall, W. H., 1; Hanslow, H., 1; Happ, S. C., 1, 2, 3, 6, 7, 8, 9, 13, 14, 15, 17, 18; Harman, J. A., 2; Harper, H. J., 2, 3, 4, 6; Higgins, G., 1; Hinds, N. E. A., 1; Humphreys, A. A., 1; Khanna, R. K., 6; Kidwell, A. L., 1; Kniffen, F. B., 1; Krynine, P. D., 1; Kunsman, H. S., 1; League of Nations, 1; Leete, F. A., 1; Little, E. L. J., 1; Lobeck, A. K., 1; Lowdermilk, W. C., 5; MacClintock, P., 1; McGee, W. J., 1; Mackin, J. H., 1; Majumdar, S. C., 1; Meinzer, O. E., 2, 3; Melton, F. A., 1; Mendenhall, W. C., 1; Merrill, W. E., 1; Mortimore, M. E., 1; Napper, C. W., 1; Needham, J. G., 1; Nichols, G., 1; Price, W. A., 1; Ray, C. N., 1; Ringland, A. C., 1; Rockie, W. A., 1; Rose, C. W., 1, 2; Rowalt, E. M., 1; Ruedemann, R., 1; Russell, R. J., 3, 4, 5; Salisbury, R. D., 1; Schwennessen, A. T., 1; Shaler, N. S., 2; Shamov, G. I., 3; Shannon, C. W., 1; Smith, H. T. U., 1, 2;

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Stearns, H. T., 1; Steinmayer, R. A., 1; Stevens, J. C., 2, 5; Stone, W. L., 1; Swanson, C. H., 1; Tarr, R. S., 2; Trowbridge, A. C., 2, 3; Turley, J., 1; Twenhofel, W. H., 13; U. S. Engineer Dept., 3; U. S. Mississippi River Commission, 10; U. S. Soil Conservation Service, 6; Vernon, R. O., 1; Viosca, P., Jr., 1; Virginia State Planning Board, 1; Watson, E. B., 1; Weeks, A. W., 1; Willey, D. A., 5; Williams, G. O., 1; Worthington, E., 1; Wright, H. T., 1; Young, S. M., 1; Anonymous, 13, 26, 74, 75

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Andrews, F. M., 1; Chapman, H. H., 1; Culbertson, G., 1; Dana, S. T., 1; Featherstonhaugh, G. W., 1; Hall, W. H., 1; Happ, S. C., 13; Harris, W. H., 1; Kucinski, K. J., 1; Mansfield, G. R., 1

Methods of investigation

Adams, C., 1, 2; Brown, C. B., 1; Happ, S. C., 4, 9, 10; Kunsman, H. S., 1; Price, W. A., 1; Rittenhouse, G., 3; U. S. Soil Conservation Service, 6

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American Society of Civil Engineers, 1; American Society of Civil Engineers, Special Committee on Floods and Flood Prevention, 1; Bates, C. G., 1; California Hydraulic Mining Commission, 1; Happ, S. C., 3, 5, 13, 15; Inglis, C. C., 24; Jameson, C. D., 1; Johnson, J. W., 8; Jones, D. M., 1; Lin, D. Y., 2; Steele, F. K., 1; U. S. Soil Conservation Service, 5; Anonymous, 170

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Alter, J. C., 1; Anderson, H. W., 1; Andrews, F. M., 1; Bailey, R. W., 1, 2, 4, 6; Bates, 1, 2, 5; Bates, E. M., 1; Baumann, P., 3; Bennett, H. H., 1; Berthoud, E. L., 1; Bissell, C. A., 1; Blackford, F. W., 1; Blackwelder, E., 2; Breeding, S. D., 1; Brown, C. B., 4, 6, 24; Brown, M. H., 1; Bruce, D. W., 1; Buhler, E. O., 1; Cameron, W. M., 1; Chapman, H. H., 1; Chawner, W. D., 1; Cole, W. S., 1; Collins, R. F., 1; Cooke, M. L., 1; Crosby, I. B., 1; Culbertson, G., 1; Dana, S. T., 1; Dappert, A. F., 1; Darrow, F. T., 1; David, T. W. E., 1; Dunklee, D. E., 1; Eaton, E. C., 1; Einstein, H. A., 2; Eliassen, S., 1; Featherstonhaugh, G. W., 1; Fairbank, J. P., 1; Filmer, E. A., 1; Finucane, K. J., 1; Fry, A. S., 1; Gilbert, G. K., 8; Griffith, W. M., 1; Grunsky, C. E., 1; Harper, H. J., 7; Harris, W. H., 1; Hatt, W. K., 1; Hinds, N. E. A., 1; Hintgen, L. N., 1; Holmes, R. S., 1; Holmquist, F. N., 1; Inglis, C. C., 69; Interstate Commission on the Potomac River Basin, 1; Ives, R. L., 1; Jahns, R. H., 1; Kenyon, E. C., Jr., 1; Kirkbride, W. H., 2; Krumbein, W. C., 22, 27; Kucinski, K. J., 1; Laverty, F. B., 1; Los Angeles Co., Calif. Flood Control District, 1; Love, S. K., 2; Lowdermilk, W. C., 1; Lukens, H. M., 1; Lynch, H. B., 1; McGlashan, 1; McKee, E. D., 1; Mansfield, G. R., 1; Meinzer, O. E., 2; Moore, B., 1; Munns, E. N., 2; Murphy, E. C., 1; Napper, C. W., 1; Pack, F. J., 1; Pasadena, Calif. Water Dept., 1; Rizer, R. L., 1; Rockie, W. A., 1, 2; Sampson, A. W., 1; Shipman, J. M., 1, 2; Silcox, F. A., 1; Smith, G., 1; Steel, T., 1; Tarr, R. S., 1; Taylor, C. A., 1; Thomson, J. P., 1; Tincher, G. W., 1; Todd, O. J., 4, 6, 7; Tompkins, W. F., 1; Torrance, W., 1; Townsend, C. M., 5; Troxell, H. C., 1; U. S. Engineer Dept., 44, 64, 75; U. S. Engineer Office, Los Angeles, California, 1; U. S. Soil Conservation Service, 2; Utah Special Flood Commission, 1; Waggoner, W. W., 1; Warmkessel, C. A., 1; Warren, C. H., 1; Williams, C. J. R., 1; Wolff, J. E., 1; Woolley, R. R., 2; Anonymous, 79, 119, 130, 155, 161

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Blaauw, G., 1; Browne, W. R., 1; Bruce, D. W., 2; Buchanan, G. C., 1; Crosby, W. O., 1; De Coverey, B. W., 1; Dixon, S. M., 1; Everatt, E. L., 1; Gottschalk, L. C., 7, 9; Haswell, C. H., 1; Haupt, L. M., 1; Heinderstam, A. V. H. von, 1; Hitch, M. A., 1; Kruckman, A., 1; Reid, H. C., 1; Rennie, J., 1; Rook, J., 1; Sherrill, C. O., 1, 2; Vernon-Harcourt, L. F., 3, 4, 5; Watt, D. A., 1; Wheeler, W. H., 2, 3, 4; Wisner, G. Y., 1; Young, S. M., 1; Anonymous, 2, 106, 120

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Methods of investigation

Caldwell, J. M., 1

Improvement of

Dredging

Brown, C. B., 9; Bruce, D. W., 2; Craighill, W. P., 1; Everatt, E. L., 1; Gottschalk, L. C., 7; Haswell, C. H., 1; Heindenstam, A. V. H. von, 1; Noll, J. J., 1; Reid, H. C., 1; Anonymous, 54

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Anderson, G. G., 1; Banks, E. J., 1; Blench, T., 1, 2; Brown, G. A. M., 1; Brown, R. M., 3; Buckley, R. B., 3, 4, 5, 6, 7; Burkov, A. F., 3; Carter, O. C. S., 1; Chang, C. C., 1; Claxton, P., 6; Cory, H. T., 2; Dowd, M. J., 1, 2, 3; Edholm, C. L., 1; Eliassen, S., 2; Etcheverry, B. A., 1; Flynn, P. J., 1; Fortier, S., 3; Framji, K. K., 4; Gibling, M. T., 1; Golze, A. R., 1; Griffith, W. M., 1; Grunsky, C. E., 5; Haigh, F. F., 1; Harris, A. L., 1; Hiranandani, M. G., 1; Houk, I. E., 3,

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Boyer, M. C., 1; Collins, W. D., 10; Corfitzen, W. E., 2; Faris, O. A., 1; Foster, L. J., 1; Grover, N. C., 12; Grunsky, C. E., 5; Hilgard, E. W., 3; Hjultström, F., 1, 2; Hooker, E. H., 1; Hoon, R. C., 1; Howard, C. S., 6, 7; India, Central Board of Irrigation, Development and Research Division, Karachi, 1; Jahns, R. H., 1; Jakuschoff, P., 1; Johnson, J. W., 3; Johnston, W. A., 1; Juritz, C. F., 1; Keller, N. D., 1; Lane, E. W., 23; Love, S. K., 1, 2, 3, 5; Maxson, J. H., 1; National Research Council, Interdivisional Committee on Density Currents, Subcommittee on Lake Mead, 1, 2, 3; Nebraska State Planning Board, 6; Parker, H. N., 1; Pittsburgh Dept. of Public Works, Bureau of Water, Filtration Division, Report, 1, 2; Riddell, J. L., 1; Robertson, L. E., 1; Rothery, S. L., 4; Sensidoni, F., 1; Shaw, A. M., 2; Simaika, Y. M., 1; Sopp, C. W., 1; Straub, L. G., 6, 7; Swartley, A. M., 1; Texas, Board of Water Engineers, 2, 4; U. S. Engineer Dept., 13, 34, 35, 36, 51, 52, 65, 67, 79, 80; U. S. Geological Survey, 4; U. S. Waterways Experiment Station, Vicksburg, Miss., 1, 14, 21, 22; Vetter, C. P., 1, 2; Wallace, R. C., 1; Whipple, W., Jr., 1; Wong, W. H., 1

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MINERALOGICAL ANALYSIS OF SEDIMENT

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Channel

Ballard, F. M., 1; Edelman, C. H., 1; King, B. F., 1; Russell, R. D., 2, 4; Sidwell, R., 1, 2, 3, 4; Smith, J. C., 1

Delta

Dohm, C. F., 1; Twenhofel, W. H., 6

Flood plain

Holmes, R. S., 1; Prince, F. S., 1

Methods of analysis

Berg, E., 1; Berg, G. A., 1; Boswell, P. G. H., 3; Grim, R. E., 1, 2, 3; Hatch, F. H., 1; King, B. F., 1; Krumbein, W. C., 14; Krynine, P. D., 3; Manger, G. E., 1; Milner, H. B., 1; Pettijohn, F. J., 2, 3; Raeburn, C., 1; Reed, R. D., 1; Ross, C. S., 1; Russell, R. D., 1, 2, 7, 9; Tester, A. C., 5; Tickell, F. G., 1; Trask, P. D., 6; Truog, E., 1; Twenhofel, W. H., 8, 12; Tyler, S. A., 1, 2

Heavy mineral

Allen, V. T., 2; Bertholf, W. E., 1; Bullard, F. M., 1; Carroll, D., 1; Cogen, W. M., 1; Doeglas, D. J., 1; Dryden, L., 2, 3, 5; Krumbein, W. C., 14; Lamar, J. E., 1; Mackie, W., 3; Otto, G. H., 1, 2; Pettijohn, F. J., 2; Rittenhouse, G., 5, 6, 7, 9, 14, 15, 16; Rubey, W. W., 7; Russell, R. D., 9; Sidwell, R., 2, 3, 4; Sindowski, F. K. H., 1; Stow, M. H., 1, 2; Taylor, G. L., 1

Petrographic

Boswell, P. G. H., 3; Carroll, D., 2; Dohm, C. F., 1; Goldman, M. I., 1, 2; Grim, R. E., 1; Hatch, F. H., 1; Howard, A. D., 1; Krumbein, W. C., 14; Larsen, E. S., 1; Mackie, W., 2; Milner, H. B., 1; Otto, G. H., 1; Pettijohn, F. J., 2; Reed, R. D., 1; Russell, R. D., 9; Thomson, E., 1; Twenhofel, W. H., 6; White, W. A., 1

X-Ray

Mehmel, M., 1; Milner, H. B., 1; Trask, P. D., 6

Suspended matter

Warmkessel, C. A., 1

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MUD FLOWS. See MASS MOVEMENT OF SEDIMENT

MUD LUMPS

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Dent, E. J., 1; Forshey, C. G., 2; Hilgard, E. W., 1, 4, 5; Humphreys, A. A., 1; Lawes, G. W., 1; Russell, R. J., 1; Schulz, E. H., 4; Shaw, E. W., 1

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Abbott, H. B., 1; Evans, L., 1; Haugen, N. P., 1; Hill, I., 1, 2

Improvement

Abbot, H. L., 3; Adams, L. M., 1, Beach, L. H., 1; Blaauw, G., 1; Brandl, I. L., 1; Buchanan, G. C., 1; California Debris Commission, 1, 2; Carson, W. W., 1; Craighill, W. P., 1; Dawson, F. M., 1; Elliott, M., 1; Engels, H., 1; Ferguson, H. B., 3; Freeman, D. B., 1, 6; Friedkin, J. F., 2; Hall, W. M., 1; Harcourt, L. F. V., 1; Harrod, B. M., 3; Hathaway, G. A., 1; Haupt, L. M., 1, 2, 3, 5; Heindenstam, A. V. H. von, 1; Kao, C. Y., 1; Le Baron, J. F., 1; Nader, J., 1; Neff, D. R., 1; Ockerson, J. A., 3; Parsons, H. F., 1; Pollitzer, S. J., 1; Preece, W. H., 1; Raymond, T. L., 1; Rennie, J., 1; Ripley, H. C., 1; Robinson, W. G., 1; Schulz, E. H., 3; Senour, C., 1; Thomas, B. F., 1; U. S. Engineer Dept., 9, 16, 28, 29, 30, 31, 32, 34, 35, 36, 37, 38, 39, 40, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 54, 55, 56, 57, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 78, 79, 81, 82, 83, 84, 85, 86, 87, 88, 94, 95; U. S. Mississippi River Commission, 9, 10; U. S. Waterways Experiment Station, Vicksburg, Miss., 11, 16; Van Frank, P. R., 1; Vernon-Harcourt, L. F., 3; Walsh, O. E., 1; Ward, E. T., 1; Anonymous, 1, 10, 34, 36, 37, 115

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Wear

Barrell, J., 2; Bell, H. S., 1; Evans, J. W., 1; Goldich, S. S., 1; India, Central Board of Irrigation, Irrigation Research Division, Poona, 1; Inglis, C. C., 15; Jackson, M. L., 1; Krumbein, W. C., 22, 23, 24, 25, 26, 27; Lane, E. W., 10; Lenher, V., 1; Marshall, P., 1; Pettijohn, F. J., 1, 4, 5; Rubey, W. W., 7; Russell, R. D., 3, 4, 6; Schoklitsch, A., 2, 4; Thiel, G. A., 1; Wentworth, C. K., 1; Woodford, A. O., 1

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Churchill, E. P., Jr., 1, 2; Coker, R. E., 1; Dan-glade, E., 1; Dean, B., 1; Edmondson, C. H., 1; Ellis, M. M., 1; Higgins, E., 3; Kellogg, J. L., 1; Lefevre, G., 1; Moore, H. F., 1, 2, 3; U. S. Circuit Court, 1; Wilson, C. B., 1, 2

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Clarke, F. W., 1; Connecticut State Water Commission, 1, 2, 3; Dole, R. B., 2; Fuller, M. L., 1; Krynine, D. P., 1; Kucinski, K. J., 1; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2

Upper Chesapeake Bay basins

Ashe, W. W., 2, 5; Baltimore Water Board, 1, 2, 3, 4, 5, 6, 7, 8, 9; Besley, F. W., 1; Brown, C. B., 34; Churchill, E. P., Jr., 1; Clarke, F. W., 1; Craighill, W. P., 1; Dole, R. B., 2; Eakin, H. M., 9; Flinn, A. D., 1; Freeman, J. R., 1; Gottschalk, L., 4, 6, 7, 9; Happ, S. C., 9; Hobbs, C. S., 1; Hunter, J. F., 1; Khosla, A. N., 2; Moore, H. F., 1; Rule, G. K., 1; Shaw, H. B., 1; Stevens, J. C., 2; Sudler, E., 1; Udden, J. A., 2; U. S. Engineer Dept., 54, 57, 81; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2; Whitman, E. B., 1

Upper Susquehanna River basin

Ashe, W. W., 2, 5; Blaess, A. F., 1; Brooks, B., 1; Clarke, F. W., 1; Collingwood, F., 1; Dappert, A. F., 1; Dole, R. B., 2, 3; Fairchild, H. L., 1; McCaffrey, A. H., 1; Reid, K. A., 1; Rose, C. W., 1, 2; Sisler, J. D., 1; Sonderegger, A. L., 2; Taylor, T. U., 6; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2; Anonymous, 130, 137, 145

West Branch Susquehanna River basin

Clarke, F. W., 1; Dole, R. B., 2, 3; Ervine, A. L., 1; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2

2 South Atlantic slope and eastern Gulf of Mexico basins

Alabama River basin

Barnes, F. F., 1; Eargle, D. H., 2; U. S. Dept. of Agriculture, 6; U. S. Engineer Dept., 75; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2

Albemarle Sound basin

Ashe, W. W., 2; Collins, W. D., 6; Dole, R. B., 2; Eakin, H. M., 9; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2

Altamaha River basin

Alldis, V. R., 1; Atlanta, Ga., Board of Water Commissioners, 1, 2; Bennett, H. H., 5, 6; Brown, C. B., 5, 7; Clarke, F. W., 1, 2; Dole, R. B., 2, 3, 7; Gustafson, A. F., 2; Ireland, H. A., 1; Kemble, F. A., 1; Khosla, A. N., 2; Lyell, C., 2; Mead, D. W., 4; Montgomery, P. H., 1; Palmer, C., 1; Rowalt, E. M., 1; U. S. Engineer Dept., 32, 38, 59, 91; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2; U. S. Forest Service, 2; Anonymous, 5

Apalachicola River basin

Ashe, W. W., 3, 5; Bennett, H. H., 6; Besley, F. W., 1; Brune, G. M., 4; Clarke, F. W., 1, 2; Dole, R. B., 2, 3, 7; Eakin, H. M., 9; Glenn, L. C., 3; Ladd, G. E., 1; Munns, E. N., 3; Needham, J. G., 1; Stallings, J. H., 1; U. S. Engineer Dept., 38, 59; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2; Vernon, R. O., 1; Anonymous, 136, 145

Cape Fear River basin

Alldis, V. R., 1; Bass, T. C., 1; Bennett, H. H., 4, 5, 6, 7; Brown, C. B., 7, 8, 16; Brune, G. M., 4; Clarke, F. W., 1, 2; Coker, R. E., 1; Connaughton, M. P., 3; Dole, R. B., 2, 3; Eakin, H. M., 9; Garin, A. N., 1, 3; Griffith, W. M., 2; Grover, N. C., 3; Gustafson, A. F., 1; Khosla, A. N., 2; Love, S. K., 1; Munns, E. N., 4; Potter, W. D., 4; Ray, C. E., 1; Roth, W. J., 1; Rowalt, E. M., 1; Saville, T., 1, 2; Stallings, J. H., 1; U. S. Engineer Dept., 59; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2; U. S. Soil Erosion Service, 1; Anonymous, 171

Carolina Coast basins

Charleston, S. C., Water Dept., 1; Clarke, F. W., 1; Craighill, W. P., 1; Dean, B., 1; Piper, A. M., 2; Ray, C. E., Jr., 1; Ripley, H. C., 1; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2

Eastern Gulf basins

Dole, R. B., 2; Ellis, M. M., 4; Pratt, J. M., 1; Sherrill, C. O., 1; Vernon, R. O., 1

Florida Peninsula basins

Clarke, F. W., 1, 2; Ramser, C. E., 6; U. S. Engineer Dept., 17; Vaughan, T. W., 1; Watt, D. A., 1

Georgia Coast basins

Clarke, F. W., 1; Dole, R. B., 2; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2; Watt, D. A., 1

James River basin

Ashe, W. W., 2, 3, 5; Bennett, H. H., 6; Clarke, F. W., 1, 2; Coker, R. E., 1; Collins, W. D., 6; Coppee, H. S. L., 1; Craighill, W. P., 1; Davis, R. O. E., 1, 2; Dole, R. B., 7; Palmer, C., 1; Richmond, Va., Water Works, 1; Stevens, J. C., 2; Stow, M. H., 1, 2; U. S. Engineer Dept., 63, 81; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2; Virginia State Planning Board, 1, 2; Whitcomb, H. D., 1; Anonymous, 48

Neuse River basin

Alldis, V. R., 1; Bass, T. C., 1; Bennett, H. H., 5; Brown, C. B., 7; Brune, G. M., 4; Clarke, F. W., 1, 2; Cooke, M. L., 1; Dole, R. B., 2, 3; Eakin, H. M., 9; Garin, A. N., 1; Griffith, W. M., 2; Gustafson, A. F., 2; Khosla, A. N., 2; Martin, I. L., 1; Munns, E. N., 3; Palmer, C., 1; Poor, R. S., 1; Ray, C. E., Jr., 1; Stallings, J. H., 1; Stevens, J. C., 2; U. S. Engineer Dept., 38, 57, 59, 81; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2; U. S. Forest Service, 2

Pearl River basin

Bennett, H. H., 6; Clarke, F. W., 1; Dole, R. B., 2, 3, 7; Lowe, E. N., 1; Palmer, C., 1; Pratt, J. M., 1; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2; U. S. Forest Service, 2; U. S. Office of Land Use Coordination, 1

Pee Dee River basin

Alldis, V. R., 1; Ashe, W. W., 5; Ayres, H. B., 1; Bennett, H. H., 5, 6; Brown, C. B., 5, 7, 8, 15; Clarke, F. W., 1, 2; Connaughton, M. P., 6; Dole, R. B., 2, 3; Eakin, H. M., 4, 9; Eargle, D. H., 3; Garin, A. N., 1; Glenn, L. C., 3; Griffith, W. M., 2; Grover, N. C., 3; Gustafson, A. F., 2; Happ, S. C., 15; Harrold, L. L., 3; Horton, R. E., 2; Hough, J. L., 5; Khosla, A. N., 2; Love, S. K., 1; Lynde, H. M., 1; Maxson, J. H., 1; Munns, E. N., 3; Palmer, C., 1; Poor, R. S., 1; Potter, W. D., 4; Ramser, C. E., 2; Ray, C. E., Jr., 1; Rowalt, E. M., 1; Sonderegger, A. L., 2; Stallings, J. H., 1; Taylor, T. U., 6; U. S. Engineer Dept., 54, 57, 81; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2; U. S. Forest Service, 2; Wilby, F. B., 1; Anonymous, 149

Roanoke River basin

Ashe, W. W., 2, 3; Bennett, H. H., 6; Clarke, F. W., 1, 2; Collins, H. H., 1; Collins, W. D., 6; Davis, R. O. E., 1, 2, 3; Dole, R. B., 2, 3; Duley, F. L., 1; Eakin, H. M., 9; Keill, P. F., 1; Palmer, C., 1; Ray, C. E., Jr., 1; Rowalt, E. M., 1; U. S.

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2 South Atlantic slope and eastern Gulf of Mexico basins--Continued.

Roanoke River basin--Continued.

Engineer Dept., 38, 59, 81; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2; Virginia State Planning Board, 1; Virginia State Planning Board, River Basin Committee, 1

Santee River basin

Alldis, V. R., 1; Anderson, A. G., 2; Ashe, W. W., 2, 5; Ayers, H. B., 1; Bass, T. C., 1; Bennett, H. H., 4, 5, 6; Brown, C. B., 5, 7, 8, 11, 12, 15, 16, 18; Chapman, H. H., 1; Clarke, F. W., 1, 2; Coker, R. E., 1; Collins, H. H., 1; Connaughton, M. P., 7; Davis, R. O. E., 1, 2; Dobson, G. C., 3, 5; Dole, R. B., 2, 3; Eakin, H. M., 9; Einstein, H. A., 2, 6, 7; Glenn, L. C., 3; Griffith, W. M., 2; Grover, N. C., 7, 12; Gustafson, A. F., 2; Happ, S. C., 15; Harris, W. H., 1; Johnson, J. W., 2, 3; Khosla, A. N., 2; Ladshaw, G. E., 1; Love, S. K., 1; Melton, F. A., 1; Munns, E. N., 3, 4; Palmer, C., 1; Ray, C. E., Jr., 1; Sharpe, C. F. S., 1; U. S. Engineer Dept., 54, 57, 59; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2; U. S. Office of Land Use Coordination, 1; Anonymous, 136

Savannah River basin

Ashe, W. W., 2, 3, 4, 5; Ayres, H. B., 1; Bennett, H. H., 6; Brown, C. B., 15; Clarke, F. W., 1, 2; Coker, R. E., 1; Craighill, W. P., 1; Davis, R. O. E., 1, 2, 3; Dole, R. B., 2, 3, 7; Duley, F. L., 1; Eakin, H. M., 9; Garvin, E. C., 1; Glenn, L. C., 3; Happ, S. C., 15; Johnson, J. W., 3, 5, 7; McCallie, S. W., 1; Millard, M. K., 1; Noll, J. J., 1; Palmer, C., 1; Sonderegger, A. L., 2; U. S. Engineer Dept., 26, 32, 38, 59, 82; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2; U. S. Forest Service, 2; Waddell, C. E., 1; Zwerner, G. A., 2

Suwannee River basin

Dole, R. B., 2

Tar River basin

Connaughton, M. P., 4; Dole, R. B., 2; Eakin, H. M., 9; Ray, C. E., Jr., 1; U. S. Engineer Dept., 32; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2

Tombigbee River basin

Brown, C. B., 7; Clarke, F. W., 1, 2; Dole, R. B., 2, 3; Eakin, H. M., 9; Eargle, D. H., 1, 4; Ellis, M. M., 4; Palmer, C., 1; Pickels, G. W., 1; Ramser, C. E., 2, 4; U. S. Engineer Dept., 55; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2; U. S. Forest Service, 2

3 Ohio River basin

Big Sandy River basin

Dole, R. B., 2; Stabler, H., 1; U. S. Engineer Dept., 76; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2; Wentworth, C. K., 2

Cumberland River basin

Brune, G. M., 2; Chittenden, H. M., 1; Clarke, F. W., 1, 2; Coker, R. E., 1; Dole, R. B., 2, 3, 4, 5, 7; Harts, W. W., 5, 6; Holmes, R. S., 2; Mead, D. W., 4; Stabler, H., 1; U. S. Engineer Dept., 48, 85, 91; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2; U. S. Waterways Experiment Station, Vicksburg, Miss., 1; Whitefield, A. F., 1; Wilson, C. B., 2; Wilson, L. S., 1

Green River basin

Breazeale, J. F., 1; Fortier, S., 3; Harts, W. W., 4; Lytel, J. L., 1; Munns, E. N., 3; Rubey, W. W., 8; Smith, T. R., 1; Stevens, J. C., 2; U. S. Engineer Dept., 49; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2; Anonymous, 51

Kanawha River basin

Ayres, H. B., 1; Bennett, H. H., 6; Brown, C. B., 2, 3, 5, 7; Collins, W. D., 6; Dappert, J. W., 1; Dole, R. B., 2; Eakin, H. M., 9; Fuller, G. L., 1; Glenn, L. C., 3; Gottschalk, L. C., 8; Grosby, 1; Kriehbaum, H., 1; Stabler, H., 1; Thompson, H., 1; U. S. Engineer Dept., 78, 85; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2; U. S. Forest Service, 2; Anonymous, 49

Kentucky River basin

Bennett, H. H., 6; Clarke, F. W., 1, 2; Dole, R. B., 2, 3, 5; Harts, W. W., 4; Mead, D. W., 4; Stabler, H., 1; U. S. Engineer Dept., 50, 85; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2

Licking River basin

Mansfield, G. R., 1

Lower Ohio River basin

Andrews, F. M., 1; Brown, C. B., 4; Brune, G. M., 1, 2; Chittenden, H. M., 1; Clarke, F. W., 1; Collins, W. D., 1; Culbertson, G., 1; Dole, R. B., 2; Hall, W. M., 1; Hazen, A., 2; Hering, R., 1; Holmes, R. S., 1, 2; Humphreys, A. A., 1; Lane, E. W., 7; McMath, R. E., 7; Malott, C. A., 1; Mansfield, G. R., 1; Mead, D. W., 2; Merrill, W. E., 1; Munns, E. N., 3; Murata, K. J., 1; Piper, A. M., 2; Powell, J. W., 1; Ramser, C. E., 4; Shannon, C. W., 1; Sonderegger, A. L., 1; Townsend, C. M., 2; Turneure, F. E., 1; U. S. Engineer Dept., 10, 85; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2; U. S. Waterways Experiment Station, Vicksburg, Miss., 1, 4, 5, 18; Vogel, H. D., 2; Woodburn, R., 1; Anonymous, 111

Miami River basin

Bennett, C. S., 1; Bennett, H. H., 6; Clarke, F. W., 1, 2; Cleary, J. B., 1; Dole, R. B., 2, 3, 6; Fortier, S., 2; Foulk, C. W., 1; Grunsky, C. E., 5; Houk, I. E., 1, 2; Lane, E. W., 7, 13; Palmer, C., 1; Sanderson, E. E., 1; Taylor, T. U., 6; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2

Middle Ohio River basin

Brown, C. B., 4; Brune, G. M., 1, 2; Clarke, F. W., 1; Dole, R. B., 2, 6; Foulk, C. W., 1; Hall, W. M., 1; Harts, W. W., 7; Hodge, W. W., 1; Holmes, R. S., 1; Lathrop, T. R., 1; McMath, R. E., 7; Mansfield, G. R., 1; Merrill, W. E., 1; Parmelee, C. L., 1; Sanderson, E. E., 1; Stabler, H., 1; Turneure, F. E., 1; U. S. Congress, Senate, Committee on Commerce, 1; U. S. Engineer Dept., 85; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2; U. S. Forest Service, 2; Vogel, H. D., 2; Whipple, G. C., 1

Monongahela River basin

Bennett, H. H., 6; Clarke, F. W., 1, 2; Dole, R. B., 2, 3; Fuentes, J. H., 1; Glenn, L. C., 3; King, B. F., 1; Pennsylvania Water Supply Commission, 1; Pittsburgh Board of Health, 1; Roberts, T. P., 1, 2; Stabler, H., 1; U. S. Engineer Dept., 85; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2

Muskingum River basin

Bennett, H. H., 6; Brown, C. B., 8; Brune, G. M., 2; Clarke, F. W., 1, 2; Delmers, F., 1; Dole, R. B., 2, 3; Eakin, H. M., 9; Foulk, C. W., 1; Harrold, L. L., 5; Harts, W. W., 4; Lathrop, T. R., 1; Mather, W. W., 1; Mitchell, R. H., 1; Morse, H. H., 1; Ramser, C. E., 9; Sanderson, E. E., 1; Simpson, W. F., 1; U. S. Engineer Dept., 94; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2; U. S. Soil Conservation Service, 8; White, C. G., 1

Sciota River basin

Brune, G. M., 2; Clarke, F. W., 1; Columbus, Ohio, Dept., of Public Service, 1; Dole, R. B., 2; Eakin, H. M., 9; Edwards, A. M., 1; Foulk, C. W., 1; Lathrop, T. R., 1; Napper, C. W., 1; Sanderson, E. E., 1; Stabler, H., 1; U. S. Congress, Senate, Committee on Commerce, 1; U. S. Engineer Dept., 85, 91; Wickliff, E. L., 1, 2; Anonymous, 117

Tennessee River basin

Ashe, W. W., 2, 3, 5; Ayres, H. B., 1; Bennett, H. H., 6; Bowden, N. W., 1; Caples, W. G., 1; Chittenden, H. M., 1; Churchill, M. A., 3, 4; Clarke, F. W., 1, 2; Collins, W. D., 6; Davis, R. O. E., 1, 2, 3; Dole, R. B., 2, 3, 5, 7; Duley, F. L., 1; Eakin, H. M., 9; Edwards, A. D., 1; Ellis, M. M., 1, 4; Emmons, W. H., 1; Engles, H., 1; Fippin, E. O., 1; Fiske, H. C., 1; Fry, A. S., 1; Glenn, L. C., 1, 2, 3; Gustafson, A. F., 2; Happ, S. C., 9; Harts, W. W., 4, 5, 6; Higgins, E., 1; Holmes, R. S., 2; Khosla, A. N., 2; King, W. R., 1; Lane, E. W., 7; Leavitt, S., 1; Lucas, B. F., 1;

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Matthes, G. H., 1; Mead, D. W., 4; Moore, W. L., 1; Munns, E. N., 3; Nicholson, J. H., 1, 2; Rappenecker, C., 1; Ray, C. E., Jr., 1; Sonderegger, A. L., 1, 2; Stabler, H., 1; Stevens, J. C., 2; Taylor, T. U., 6; Trullinger, R. W., 1; U. S. Engineer Dept., 29, 54, 57, 81, 83, 85, 91; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2; U. S. Tennessee Valley Authority, 1, 2, 3; U. S. Waterways Experiment Station, Vicksburg, Miss., 1; Waddell, C. E., 1; Wiebe, A. H., 1, 2, 3; Wilby, F. B., 1; Zón, R., 1; Anonymous, 122, 140, 142

Upper Ohio River basin

Brune, G. M., 2; Clarke, F. W., 1, 2; Dole, R. B., 2, 3; Fuertes, J. H., 1; Hering, R., 1; Holmes, R. S., 1; King, B. F., 1; McMath, R. E., 7; Mead, D. W., 4; Merrill, W. E., 1; Pittsburgh Board of Health, 1; Pittsburgh Dept. of Public Works, Bureau of Water Filtration Division, 1, 2; Stabler, H., 1; Turneure, F. E., 1; U. S. Engineer Dept., 85; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2; U. S. Forest Service, 2

Wabash River basin

Bennett, H. H., 6; Brune, G. M., 2, 3, 8; Clarke, F. W., 1, 2; Coker, R. E., 1; Collins, W. D., 1; Cummings, E. R., 1; Dappert, J. W., 1; Dole, R. B., 2, 3, 4, 5; Dryer, C. R., 1, 3; Harman, J. A., 1; Harris, R. J., 1; Hatt, W. K., 1; Malott, C. A., 1; Mead, D. W., 1, 4; Ramser, C. E., 2; Reagan, A. B., 1; Shannon, C. W., 1; Swanson, C. H., 1; U. S. Engineer Dept., 72; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2

Youghiogheny River basin

Clarke, F. W., 1; Dole, R. B., 3; Palmer, C., 1; Stabler, H., 1; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2

4 St. Lawrence River basin

Lake Champlain basin

Altpeter, L., 1; Clarke, F. W., 1, 2; Dunklee, D. E., 1; Shipman, J. M., 1, 2; Zile, R. R., 1

Lake Erie basin

Bowman, I., 1; Clarke, F. W., 1, 2; Coker, R. E., 1; Dole, R. B., 2, 3; Engeln, O. D. von, 1; Foulk, C. W., 1; Langlois, T. H., 1; Lathrop, T. R., 1; Palmer, C., 1; Parkins, A. E., 1, 2; Sanderson, E. E., 1; Sears, P. B., 1; Symons, G. E., 1; U. S. Dept. of Agriculture, 8; U. S. Engineer Dept., 23; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2; Wilson, C. B., 1; Wisner, G. Y., 2

Lake Huron basin

Clarke, F. W., 1, 2; Dole, R. B., 2; Lane, E. W., 3; Langlois, T. H., 1; Palmer, C., 1; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2; Anonymous, 145

Lake Michigan basin

Bennett, H. H., 7; Clarke, F. W., 1, 2; Coker, R. E., 1; Collins, W. D., 1; Dole, R. B., 2, 3; Downes, S. B., 1; Eschmeyer, R. W., 1; Evans, O. F., 6; Hough, J. L., 1; Lane, E. W., 3; Palmer, C., 1; U. S. Engineer Dept., 40, 42; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2

Lake Ontario basin

Clarke, F. W., 1; Cole, W. S., 1; Dappert, A. F., 1; Dole, R. B., 2; Dryer, C. R., 2; Engeln, O. D. von, 2; Fairchild, H. L., 1; Filmer, E. A., 1; Gilbert, G. K., 4, 7; Gustafson, A. F., 2; New York (State), Division of State Planning, 1; Palmer, C., 1; Rule, G. K., 1; Scheifele, O. S., 1; Townsend, C. M., 5; Anonymous, 34, 86, 130

Lake Superior basin

Clarke, F. W., 1, 2; Dole, R. B., 2, 4; Ellis, M. M., 4; Palmer, C., 1; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2; Walker, T. D., 1

St. Lawrence River basin

Clarke, F. W., 1, 2; Dole, R. B., 2; Ellis, M. M., 4; Freeman, J. R., 3; Palmer, C., 1; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2

5 Hudson Bay and upper Mississippi River basins

Chippewa River basin

Bates, C. G., 4; Bennett, H. H., 6; Clarke, F. W., 1, 2; Dole, R. B., 2, 3; Ellis, M. M., 4; Lane, E. W., 7; Mead, D. W., 4; Stevens, J. C., 2; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2

Des Moines River basin

Allen, C. R., 1, 2; Clarke, F. W., 1, 2; Coker, R. E., 1; Cooke, M. L., 1; Dole, R. B., 2, 3, 4, 5; Galtsoff, P. S., 1; Hutton, M. L., 1; Iowa State Planning Board, Water Resources Committee, 1; Marston, G. A., 1; Reichstein, A., 1; Schlick, W. J., 1; Sherman, E. A., 1; Smith, G. P., 1; Taylor, T. U., 6; Trullinger, R. W., 1; U. S. Engineer Dept., 30; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2; U. S. Waterways Experiment Station, Vicksburg, Miss., 1; Van Driest, E. R., 1; Anonymous, 16

Devils Lake - Red River basin

Clarke, F. W., 1, 2; Dole, R. B., 1, 2; Griggs, R. F., 1; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2; Wallace, R. C., 1; Woolman, A. J., 1

Illinois River basin

Anderson, S. T., 1; Barrows, H. H., 1; Bennett, H. H., 6; Brown, C. B., 5, 7, 14, 30, 36; Clarke, F. W., 1, 2; Coker, R. E., 1; Collins, W. D., 1; Cooley, L. E., 2; Danglede, E., 1; Dappert, J. W., 1; Dole, R. B., 2, 3, 4, 5; Eakin, H. M., 9; Gersbacher, W. M., 1; Glymph, L. M., 4; Harman, J. A., 3; Jones, V. H., 3, 4; Mead, D. W., 1, 2, 4; Rubey, W. W., 1, 4; Stall, J. B., 1; Stevens, J. C., 2; Townsend, C. M., 2, 3; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2; U. S. Forest Service, 2; U. S. Waterways Experiment Station, Vicksburg, Miss., 1, 9; Wallace, R. C., 1; Wilson, J. D., 1; Anonymous, 145

Iowa River basin

Bennett, H. H., 6; Blue, F. L., Jr., 1; Clarke, F. W., 1, 2; Coker, R. E., 1; Dole, R. B., 2, 3, 4; Eakin, H. M., 9; Galtsoff, P. S., 1; Hutton, M. L., 1; Marston, G. A., 1; Péwé, T. L., 2; Ramser, C. E., 4; Trullinger, R. W., 1; U. S. Engineer Dept., 28; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2; U. S. Waterways Experiment Station, Vicksburg, Miss., 1; Wallace, R. C., 1

Kaskaskia River basin

Clarke, F. W., 1, 2; Collins, W. D., 1; Dole, R. B., 2, 3; Illinois Dept. of Public Works and Buildings, Division of Waterways, 1; Mead, D. W., 1; Ramser, C. E., 6; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2

Middle Mississippi River basin

Adams, C., 1, 2, 3; Beckman, H. C., 1; Bennett, H. H., 6; Brown, C. B., 7, 27; Brune, G. M., 9; Bull, A. W., 1; Burns, B. F., 1; Carmen, J. E., 1; Clarke, F. W., 1, 2; Collins, H. H., 1; Collins, W. D., 1; Dappert, J. W., 1; Darling, J. N., 1; Dole, R. B., 2, 3, 4, 5; Dunbar, W., 1; DuShane, J. D., 1; Eads, J. B., 1; Eakin, H. M., 9; Ellis, M. M., 4; Flad, H., 1; Freeman, J. R., 1, 3; Galtsoff, P. S., 1; Glymph, L. M., 5; Griffith, W. M., 2; Gustafson, A. F., 1, 2; Happ, S. C., 9, 12, 13; Haugen, N. P., 1; Holmes, R. S., 2; Jones, V. H., 10; Khosla, A. N., 2; Linderman, E. F., 1; Lugn, A. L., 2; McMath, R. E., 3, 4, 7; Marston, G. A., 1; Mead, D. W., 1, 2, 4; Palmer, C., 1; Parker, F. Y., 1, 2; Péwé, T. L., 1; Piper, A. M., 1; Powell, J. W., 1; Ramser, C. E., 4; Rubey, W. W., 8; Saint Louis Board of Water Commissioners, 1; Saint Louis Water Dept., Supply and Purifying Division, 1; Sheppard, C. A., 1; Stevens, J. C., 2; Swenson, F. A., 1; Todd, O. J., 10; Townsend, C. M., 2, 3; Trowbridge, A. C., 2; Trullinger, R. W., 1; U. S. Congress, Senate, Committee on Commerce, 1; U. S. Engineer Dept., 2, 4, 9, 31, 46, 77; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2; U. S. Forest Service, 2; U. S. Mississippi River Commission, 2, 4, 10; U. S. Office of Land Use Coordination, 1; U. S. Water-

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Middle Mississippi River basin--Continued.

ways Experiment Station, Vicksburg, Miss., 1, 4, 16, 23; Vogel, H. D., 1; Wall, E. E., 1; Woermann, J. W., 1; Young, C. H., 1; Anonymous, 3, 53, 111, 113

Minnesota River basin

Bennett, H. H., 6; Clarke, F. W., 1, 2; Dole, R. B., 1, 2, 3, 4; Mead, D. W., 2; Townsend, C. M., 2, 3; U. S. Engineer Dept., 84; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2; Woolman, A. J., 1

Rainy River basin

Clarke, F. W., 1, 2; Dole, R. B., 2, 3, 7; Duley, F. L., 1; Mead, D. W., 4; Moore, E., 2; Palmer, C., 1; Reade, M. T., 1; Wallace, R. C., 1

Rock River basin

Clarke, F. W., 1, 2; Collins, W. D., 1; Dappert, J. W., 1; Dole, R. B., 2, 3; Eakin, H. M., 9; Fenneman, N. M., 1; Galtsoff, P. S., 1; Gustafson, A. F., 2; Khosla, A. N., 2; Mead, D. W., 1, 2; Twenhofel, W. H., 4; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2; U. S. Waterways Experiment Station, Vicksburg, Miss., 1

St. Croix River basin

Dole, R. B., 2, 4; Ellis, M. M., 4; Udden, J. A., 2; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2

Skunk River basin

Clarke, F. W., 1; Iowa State Planning Board, Water Resources Committee, 1; Marston, G. A., 1; Ramser, C. E., 4; Taylor, T. U., 7; Trullinger, R. W., 1; U. S. Engineer Dept., 45; Young, C. H., 1

Upper Mississippi River basin

American Society of Civil Engineers, Special Committee on Floods and Flood Prevention, 1; Ashe, W. W., 2, 5; Ballou, W. H., 1; Bates, C. G., 4, 5, 6; Bennett, H. H., 6, 8; Brown, C. B., 12; Brune, G. M., 9; Clarke, F. W., 1, 2; Clyde, G. D., 1; Collins, W. D., 8; Coppee, H. S. L., 1; Davis, R. O. E., 1; Dole, R. B., 1, 2, 3, 4, 5; DuShane, J. D., 1; Eakin, H. M., 9; Ellis, M. M., 4; Fawkes, A. W. E., 1; Fry, J. R., Jr., 1; Galtsoff, P. S., 1; Grover, N. C., 4; Gustafson, A. F., 2; Happ, S. C., 9, 17; Harts, W. W., 2; Kunsman, H. S., 1; Lane, E. W., 7; Lefevre, G., 1; Love, S. K., 1; Mead, D. W., 2, 4; Munns, E. N., 3; Ockerson, J. A., 1; Palmer, C., 1; Potter, W. D., 2; Smith, E. G., 1; Sonderegger, A. L., 2; Starling, W., 4; Stevens, J. C., 2; Taylor, T. U., 6; Todd, O. J., 10; Townsend, C. M., 2, 3; U. S. Engineer Dept., 8, 54, 57, 81, 83; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2; U. S. Forest Service, 2; U. S. Mississippi River Commission, 4, 10; U. S. Soil Conservation Service, 3; U. S. Soil Conservation Service, Upper Mississippi Region, 1; U. S. Waterways Experiment Station, Vicksburg, Miss., 1; Wolfe, E., 1; Anonymous, 145, 162

Wisconsin River basin

Bates, C. G., 3; Bates, R. E., 1; Clarke, F. W., 1, 2; Dole, R. B., 2, 3, 4, 5; Downes, S. B., 1; Edwards, F. W., 1; Galtsoff, P. S., 1; Harza, L. F., 1; Herschel, C., 1; Kunsman, H. S., 1; Lane, E. W., 3; Munns, E. N., 3; Stevens, J. C., 2; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2

6 Missouri River basin

Big Horn River basin

Eakin, H. M., 9; Etcheverry, B. A., 2; Gustafson, A. F., 2; Hall, L. S., 1; Mackin, J. H., 1; Morison, G. W., 1; Sonderegger, A. L., 2; Stabler, H., 3; Stevens, J. C., 2, 5; Taylor, T. U., 7; U. S. Bureau of Reclamation, 4; U. S. Engineer Dept., 74, 80; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2

Cheyenne River basin

Brown, C. B., 12; Plumley, W. J., 1; Robinson, W. G., 1; Rubey, W. W., 2; Stabler, H., 3; Stevens, J. C., 2; Udden, J. A., 2; U. S. Engineer Dept., 34, 80; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2

Gasconade River basin

Beckman, H. C., 1; Clarke, F. W., 1; Stevens, J. C., 2; U. S. Engineer Dept., 35, 80; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2

James River basin

Bennett, H. H., 6; Brown, C. B., 12; Clarke, F. W., 1, 2; Dole, R. B., 3; U. S. Engineer Dept., 62, 80; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2

Kansas River basin

Ashe, W. W., 4, 5; Beckman, H. C., 1; Bennett, H. H., 6; Brown, C. B., 7, 12; Clarke, F. W., 1, 2; Collins, H. H., 1; Connaughton, M. P., 1; Darrow, F. T., 1; Dole, R. B., 2; Eakin, H. M., 9; Flaxman, E. M., 1; Grover, N. C., 5; Hall, L. S., 1; Hansen, O. C., 1; Jones, V. H., 9; Lane, E. W., 7; Love, S. K., 1; Morse, F. T., 1; Murphy, E. C., 1; Murray, E. B., 1; Nebraska State Planning Board, 6; Parker, H. N., 1; Parkhurst, V. R., 1; Perkins, F. C., 1; Robinson, H. F., 1; Ruckman, J. N., 1, 2; Schulz, E. H., 1, 2; Smyth, B. B., 1; Sonderegger, A. L., 2; Stabler, H., 2; Steele, F. K., 1; Stevens, J. C., 2; Taylor, T. U., 7; Tincher, G. W., 1; U. S. Engineer Dept., 79, 80; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2; U. S. Forest Service, 2; U. S. Office of Land Use Coordination, 1; Wilby, F. B., 1; Anonymous, 10

Little Missouri River basin

Brown, C. B., 12; Stevens, J. C., 2; U. S. Engineer Dept., 51; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2

Lower Missouri River basin

Ashe, W. W., 2, 5; Atwood, W. G., 1; Barrell, J., 1; Beckman, H. C., 1; Bennett, H. H., 1, 2, 3, 6; Brown, C. B., 6; Brune, G. M., 9; Bull, A. W., 1; Chamberlain, J. R., 1; Chittenden, H. M., 1; Clarke, F. W., 1, 2; Clarke, H. T., 1; Collins, H. H., 1; Connaughton, M. P., 5; Cooley, L. E., 1; Craighill, W. P., 1; Curd, W. C., 1; Dappert, J. W., 1; Darling, J. N., 2; Davis, R. O. E., 1, 2; Dawson, F. M., 1; Dean, S., 1; Doane, T., 1; Dobbins, H. T., 1; Dole, R. B., 3, 5, 7; Duley, F. L., 1; Duncanson, H. B., 1; Eakin, H. M., 9; Ellis, M. M., 4; Everham, A. C., 1; Fox, S. W., 1; Freeman, D. B., 1; Freeman, J. R., 2, 3; Galtsoff, P. S., 1; Grover, N. C., 9; Hall, L. S., 1; Handbury, T. H., 1; Happ, S. C., 9; Harman, J. A., 1; Harrod, B. M., 1; Harts, W. W., 5; Hazen, A., 2; Hedberg, H. D., 1; Hodgeson, P. A., 1; Hooker, E. H., 1; Jones, V. H., 7, 8; Kiersted, W., 1; Knerr, E. B., 1; Lane, E. W., 7; Love, S. K., 1; Lugn, A. L., 2; McMath, R. E., 1, 6; Marston, G. A., 1; Mead, D. W., 4; Morison, G. W., 1; Neff, D. R., 1; Ockerson, J. A., 1, 4, 5; Palmer, C., 1; Parker, F. Y., 4, 5; Parker, H. N., 1; Parsons, H. F., 1; Paul, G. F., 2; Perkins, F. C., 1; Piper, A. M., 2; Potter, W. D., 1; Powell, J. W., 1; Red Cross, U. S. American National Red Cross, Board of Engineers, 2; Ruckman, J. N., 1; Scheifele, O. S., 1; Schoenleber, L. H., 1; Schulz, E. H., 1, 2; Seddon, J. A., 2; Simpich, F., 1; Slade, J. J., 1; Smith, E. G., 1; Smith, F. R., 1; Smyser, R. E., Jr., 1; Sonderegger, A. L., 2; Starling, W., 2, 4; Stevens, J. C., 2; Straub, L. G., 1, 3, 5, 6, 9, 12, 13; Taylor, T. U., 6; Todd, O. J., 10; Towl, R. N., 2, 3, 4, 8; Townsend, C. M., 2, 3; Trullinger, R. W., 1; U. S. Engineer Dept., 4, 9, 14, 34, 35, 36, 51, 52, 58, 62, 65, 66, 67, 73, 79, 80, 81, 83, 85, 93; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2; U. S. Mississippi River Commission, 2, 10; U. S. Missouri River Commission, Physical Data Dept., 1; U. S. Reclamation Service, 2; U. S. Waterways Experiment Station, Vicksburg, Miss., 1; Vogel, H. D., 1; Wall, E. E., 1, 2; Walsh, O. E., 1; Whipple, W., Jr., 1; Whitaker, R., 1; Wilby, F. B., 1; Willey, D. A., 1; Woermann, J. W., 1; Woods, A. F., 1; Woods, M. W., 1; Woodward, C. M., 1; Young, G. R., 1; Young, J. M., 1; Zingg, A. W., 1; Anonymous, 17, 59, 82, 93, 111, 115, 124

Lower Platte River basin

Albert, F. C., 1; Bennett, H. H., 6; Boughton, V. T., 1; Brown, C. B., 12; Clarke, F. W., 1, 2; Cooley, L. E., 1; Dole, R. B., 2, 3; Harza, L. F., 2; Holmes, R. S., 2; Nagle, J. C., 1; Nebraska

RIVER BASINS - UNITED STATES- CONTINUED.

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Lower Platte River basin--Continued.

State Planning Board, 2; 3; Stevens, J. C., 2; Towl, R. N., 4, 8; U. S. Engineer Dept., 80; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2; Woods, A. F., 1; Anonymous, 132, 141, 151

Middle Missouri River basin

Abbott, H. C., 1; Ballou, W. H., 1; Bennett, H. H., 6; Bull, A. W., 1; Burnet, G., 1; Chamberlain, J. R., 1; Clarke, F. W., 1, 2; Connaughton, M. P., 1, 2; Crane, J. L., 1; Dean, S., 2; Doane, T., 1; Dole, R. B., 2, 4; Eakin, H. M., 9; Etnyre, S. L., 1; Fox, S. W., 1; Glymph, L. M., Jr., 7; Gottschalk, L. C., 10, 11; Hintgen, L. N., 1; Hodgeson, P. A., 1; Holmes, R. S., 2; Hutton, M. L., 1; Lamp, G. C., 1; Lane, E. W., 14; Lugn, A. L., 2; McDowall, G. W., 1; Melton, F. A., 1; Morison, G. W., 1; Mortimore, M. E., 1; Ocker-son, J. A., 1; Pickels, G. W., 1; Ramser, C. E., 2, 4, 6, 7, 9; Schulz, E. H., 1; Stevens, J. C., 2; Taylor, T. U., 7; Todd, J. E., 1; Tomson, F. D., 1; Towl, R. N., 1, 3, 4, 5, 8, 9; Townsend, C. M., 2, 3; Trench, W. L. C., 1; Trullinger, R. W., 1; Udden, J. A., 2; U. S. Dept. of Agriculture, 7; U. S. Engineer Dept., 33, 34, 52, 58, 65, 73, 80; U. S. Federal Inter-Agency River Basin Com-mittee, Subcommittee on Sedimentation, 2; U. S. Forest Service, 2; U. S. Waterways Experiment Station, Vicksburg, Miss., 1; Ward, F., 1; Whipple, W., Jr., 1; Anonymous, 65, 73

Milk River basin

Brown, C. B., 12; Dole, R. B., 2; Holmes, R. S., 2; Kerr, C. H., 1; Stabler, H., 3; Stevens, J. C., 2; U. S. Engineer Dept., 52, 80; U. S. Federal Inter-Agency River Basin Committee, Subcom-mittee on Sedimentation, 2

Niobrara River basin

Brown, C. B., 12; Clarke, F. W., 1; Nebraska State Planning Board, 4; Stevens, J. C., 2; U. S. Engineer Dept., 65, 80; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2

North Platte River basin

Boughton, V. T., 1; Clarke, F. W., 1, 2; Dole, R. B., 3; Fortier, S., 2; Grunsky, C. E., 5; Gustaf-son, A. F., 2; Hall, L. S., 1; Houk, I. E., 3; Keimig, J. A., 1; Khosla, A. N., 2; Mead, D. W., 4; Nagle, J. C., 1; Nebraska State Planning

Board, 1, 5; Seavy, L. M., 2; Seiler, J. F., 1; Simon, J. R., 1; Sonderegger, A. L., 2; Stevens, J. C., 2; Towl, R. N., 8; U. S. Engineer Dept., 67, 80; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2; Anonymous, 124, 166

Osage River basin

Beckman, H. C., 1; Brown, C. B., 12; Clarke, F. W., 1, 2; Ellis, M. M., 4; Hall, L., 1; Parker, H. N., 1; Smyth, B. B., 1; Stevens, J. C., 2; U. S. Engineer Dept., 66, 80; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2

Powder River basin

Cleary, J. B., 1; Eakin, H. M., 9; U. S. Engineer Dept., 80; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimenta-tion, 2

South Platte River basin

Anderson, G. G., 1; Berthoud, E. L., 1; Boughton, V. T., 1; Brown, C. B., 8; Carpenter, L. G., 2; Clarke, F. W., 2, 3; Crafts, H. A., 1; Dana, S. T., 1; Denver, Cherry Creek Flood Commission, 1; Eakin, H. M., 9; Fuertes, J. H., 1; Gustafson, A. F., 2; Headden, W. P., 1; Sonderegger, A. L., 2; Stevens, J. C., 2; Taylor, T. U., 6; Towl, R. N., 8; U. S. Engineer Dept., 67, 80; U. S. Federal Inter-Agency River Basin Committee, Subcom-mittee on Sedimentation, 2

Upper Missouri River basin

Ashe, W. W., 2; Ayers, A. H., 1; Dole, R. B., 2; Fox, S. W., 1; Holmes, R. S., 2; Mead, W. J., 1; Pyle, F. D., 1; Smith, E. G., 1; Starling, W., 4; Stevens, J. C., 2; Stevens, R. B., 1; Straub, L. G., 7; U. S. Engineer Dept., 43, 52, 80; U. S. Fed-eral Inter-Agency River Basin Committee, Sub-committee on Sedimentation, 2; Young, J. M., 1; Anonymous, 125

White River basin

Brown, C. B., 12; Nebraska State Planning Board, 7; U. S. Engineer Dept., 73, 80; U. S. Federal Inter-Agency River Basin Committee, Subcom-mittee on Sedimentation, 2

Yellowstone River basin

Bennett, H. H., 6; Brown, C. B., 12; Clarke, F. W., 1, 2; Connaughton, M. P., 1; Dole, R. B., 2; Eakin, H. M., 9; Hall, L. S., 1; Holmes, R. S., 2; Jones, V. H., 5; Ruedemann, R., 1; Seavy, L. M., 3; Stabler, H., 3; Stevens, J. C., 2; U. S. Engi-neer Dept., 74, 80; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedi-mentation, 2; U. S. Forest Service, 2

7 Lower Mississippi River basin

Canadian River basin

Bollinger, C. J., 1; Clarke, F. W., 1; Eakin, H. M., 9; Evans, O. F., 2, 3, 4, 5; Featherly, H. I., 1; Harper, H. J., 2, 4, 6; Hinckley, H. V., 1; Lane, E. W., 20; Little, E. L. J., 1; Melton, F. A., 1; Phillips, H., 1; Ruckman, J. N., 1; Sidwell, R., 2; Stabler, H., 3; Starling, W., 4; Stevens, J. C., 2; Tanner, W. F., 1; U. S. Engineer Dept., 83, 87, 88; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sediamenta-tion, 2; U. S. Waterways Experiment Station, Vicksburg, Miss., 4; Wilby, F. B., 1; Williams, H. C., 1; Yeo, H. W., 1; Anonymous, 53, 111

Central Arkansas River basin

Clarke, F. W., 1, 2; Connaughton, M. P., 1; Dole, R. B., 2, 8; Eakin, H. M., 9; Harper, H. J., 1, 2, 3; Humphrey, J. S., 1; Mead, J. R., 1; Parker, H. N., 1; Smyth, B. B., 1; Stevens, J. C., 2; U. S. Engineer Dept., 83; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedi-mentation, 2; U. S. Waterways Experiment Sta-tion, Vicksburg, Miss., 4; Wilby, F. B., 1; Anonymous, 111

Cimarron River basin

Alldis, V. R., 1; Allis, J. A., 1; Barnes, G. A., 1; Bennett, H. H., 5; Bollinger, C. J., 1; Brown, C. B., 7; Clarke, F. W., 1, 2; Connaughton, M. P., 1; Dole, R. B., 8; Eakin, H. M., 4, 9; Frye, J. C., 1; Griffith, W. M., 2; Grover, N. C., 8; Gustaf-son, A. F., 2; Hall, L. S., 1; Harper, H. J., 1, 2, 3, 5; Jones, R. W., 1; Khosla, A. N., 2; Love, S. K., 1; McCormack, J. T., 1; McLaughlin, T. G., 1; Matthes, G. H., 3; Munns, E. N., 3; Parker, H. N., 1; Poor, R. S., 1; Ruckman, J. N., 1; Slosser, J. W., 1; Smith, H. T. U., 2; Starling, W., 4; Stevens, J. C., 2; U. S. Engineer Dept., 83; U. S. Federal Inter-Agency River Basin Com-mittee, Subcommittee on Sedimentation, 2; U. S. Forest Service, 2; U. S. Waterways Experiment Station, Vicksburg, Miss., 4; Wilby, F. B., 1; Anonymous, 111

Lower Arkansas River basin

Ashe, W. W., 2, 5; Barnes, G. A., 1; Bennett, H. H., 6; Branner, J. C., 1; Brown, C. B., 7; Bull, A. W., 1; Clarke, F. W., 1, 2; Coldwell, A. E., 1; Dole, R. B., 2, 3, 4, 5, 8; Driver, W. J., 1; Eakin, H. M., 9; Glymph, L. M., Jr., 1, 2, 3; Hall, L. S., 1; Harper, H. J., 7; Holmes, R. S., 2; Hooker, E. H., 1; Jones, V. H., 2, 6; Lahmer, J. A., 1; Mead, D. W., 4; Norton, J. H., 1; Ruckman, J. N., 1; Sonderegger, A. L., 1, 2; Starling, W., 4; Stevens, J. C., 2; Taylor, T. U., 6; Towl, R. N., 8; U. S. Engineer Dept., 54, 57, 81, 83; U. S. Fed-eral Inter-Agency River Basin Committee, Sub-committee on Sedimentation, 2; U. S. Waterways Experiment Station, Vicksburg, Miss., 1, 4; Van Frank, P. R., 1; Walker, M. L., 1; Wilby, F. B., 1; Anonymous, 52, 111

Lower Mississippi River basin

Abbot, H. L., 1, 2, 3; Agar, W. M., 1; Alldis, V. R., 1; American Society of Civil Engineers, Special Committee on Floods and Flood Preven-tion, 1; Atwood, W. W., 1; Babb, C. C., 2; Baker, C. L., 1; Ballou, W. H., 1; Barrell, J., 1; Barry, A. C., 1; Beach, L. H., 1; Beckman, H. C., 1; Bennett, H. H., 6, 7; Bentzel, C. E., 1; Bowie, A. J., 1; Bowman, I., 1; Brewer, W. H., 1; Brown, A., 1; Brown, C. B., 7, 12; Brown, L., 1; Brown, L. W., 1, 2; Brown, R. M., 1, 2; Bull, A. W., 1; Carey, W. C., 1; Carson, W. W., 1; Cefalu, F. D., 1; Chamberlain, J. R., 2; Chang, Y. L., 1; Chat-

RIVER BASINS - UNITED STATES--CONTINUED.

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Lower Mississippi River basin--Continued.

Iley, H., 11; Chester, C. P., 1; Clarke, F. W., 1, 2; Claxton, P., 7, 8; Clemson, T. G., 1; Coker, R. E., 1; Coleman, J. F., 1; Cooke, M. L., 1; Coppee, H. S. L., 1; Corthell, E. L., 1, 2, 3; Cory, H. T., 2; Curd, W. C., 1; Dabney, A. L., 2; Daly, R. A., 1, 3; Dappert, J. W., 1; Davis, A. P., 10; Davis, R. O. E., 1; De Berard, W. W., 1; Dent, E. J., 1, 2, 3, 4; Dohm, C. F., 1; Dole, R. B., 2, 3, 7, 8; Driver, W. J., 1; Duley, F. L., 1; Dunbar, W., 1; Dunn, H. H., 1; Eads, J. B., 2, 3, 4, 5, 6, 7; Eakin, H. M., 5, 6; Eden, E. W., Jr., 1; Elliott, D. O., 1; Ellis, M. M., 4, 6; Ellis, T. G., 1; Engels, H., 1, 2; Fairchild, H. L., 1; Faris, O. A., 1; Ferguson, H. B., 1, 2, 3; Fisk, H. N., 1, 2, 3; Fontaine, E., 1; Forshey, C. G., 1, 2, 3; Freeman, J. R., 2, 3, 4; Friedkin, J. F., 2; Gifford, J., 1; Goldstein, A., Jr., 1; Goodrich, R. D., 1; Goss, A., 1; Gotwals, J. C., 1; Greene, C. E., 1; Griffith, W. M., 1; Grunsky, C. E., 6; Gustafson, A. F., 2; Haas, W. H., 2, 3; Hall, W. H., 1; Happ, S. C., 9; Harding, H. M., 1; Harrod, B. M., 1, 2, 3, 4; Harts, W. W., 5; Haupt, L. M., 2, 3, 5; Hedberg, H. D., 1; Heidenstam, A. V. H. von, 1; Henshaw, G. H., 1; Hering, R., 1; Herschel, C., 1; Hibbs, B., 1; Hider, A., 1; Higgins, E., 1, 2; Hilgard, E. W., 1, 4; Hjulström, F., 3; Holmes, R. S., 2; Hooker, E. H., 1; Howard, D. S., 1, 2; Howell, R. P., 1; Humphreys, A. A., 1; Hunt, T. S., 1; Irvine, E. S. J., 1, 2; Jackson, T. H., 1; Johnson, D., 2; Johnson, E. N., 1; Johnson, J. B., 1, 2; Johnston, W. A., 1; Jones, V. H., 1; Kelly, W., 1; Kidwell, A. L., 1; King, F. H., 1; Klorer, J., 1; Kramer, H., 2; Krumbein, W. C., 18; Lane, E. W., 4, 7, 15; Lawes, G. W., 1; Lawson, A. C., 1; Le Baron, J. F., 1; Legget, R. F., 1; Le Vasseur, C., 1; Lipsey, T. E. L., 1; Littlefield, M., 1; Lougee, R. J., 1; Lyell, C., 1; McAlpine, W. J., 1; McBeth, W. A., 1; McLoud, N. G., 1; McMath, R. E., 1, 2, 3, 4, 5, 6, 7; Markham, E. M., 1; Marr, R. A., 1; Matthes, G. H., 3, 6; Matthews, E. R., 2; Mavis, F. T., 2; Mead, D. W., 4; Melton, F. A., 1; Moore, H. F., 2; Morgan, A. E., 1; Murata, K. J., 1; Nader, J., 1; Newell, F. H., 3; Ockerson, J. A., 1, 2, 3, 4, 5, 6; Palmer, C., 1; Parmelee, L. R., 1; Parsons, H. F., 1; Paul, G. F., 1; Phillips, H., 1; Pickells, G. W., 1; Pickett, A. B., 1; Pintard, J., 1; Piper, A. M., 2; Powell, J. W., 1; Quinn, J. B., 1; Ralston, R. R., 1; Ramser, C. E., 1, 2, 3, 4, 6, 7, 9; Raymond, T. L., 1; Reade, M. T., 1; Red Cross, U. S. American National Red Cross, Board of Engineers, 2; Richart, F. E., 1; Riddell, J. L., 1; Ripley, H. C., 1; Robbins, A. G., 1; Roberts, B. S., 1; Roberts, M. W., 1, 2; Roberts, T. P., 1; Rossiter, E. A., 1; Russell, R. D., 2, 3, 4, 6, 8; Russell, R. J., 1, 2, 3, 4, 5, 6; Salisbury, E. F., 1; Scheifele, O. S., 1; Schull, C. A., 1; Schulz, E. H., 3, 4, 5, 6; Schuyler, J. D., 3; Sen Gupta, D. N., 1; Senour, C., 2, 3; Shaler, N. S., 1, 2; Shaw, A. M., 1; Shaw, E. W., 1, 2; Sherrill, C. O., 1, 2; Smith, L. B., 1; Sonderegger, A. L., 1; Starling, W., 1, 2, 3, 4, 5, 6, 7; Steinmayer, R. A., 1, 2; Stevens, J. C., 2; Stockford, J. A., 1; Stone, C. H., 1; Straub, L. G., 6, 7, 10; Swain, G. F., 1; Taylor, R. S., 1; Taylor, T. U., 7; Tennessee State Planning Commission, 1; Thrupp, E. C., 1; Tiffany, J. B., Jr., 1; Todd, O. J., 10; Tompkins, W. F., 1, 2; Tower, W. S., 1; Towl, R. N., 6, 8; Townsend, C. M., 1, 2, 3, 4; Trowbridge, A. C., 3, 4, 6; Trullinger, R. W., 1; Twenhofel, W. H., 1, 6, 7; Tyler, M. C., 1; U. S. Engineer Dept., 5, 6, 7, 8, 12, 13, 20, 22, 24, 41, 53, 54, 57, 80, 81, 85, 92, 95; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2; U. S. Forest Service, 2; U. S. Mississippi River Commission, 1, 2, 3, 5, 6, 7, 8, 9, 10, 11; U. S. Waterways Experiment Station, Vicksburg, Miss., 1, 4, 6, 7, 10, 11, 13, 14, 15, 17, 20, 21, 22; Van Orman, C. R., 1; Vernon, R. O., 1; Viosca, P., Jr., 1; Vogel, H. D., 1, 2, 3, 4, 5, 7, 9; Wallace, R. C., 1; Washburn, A. E., 1; Waters, W. F., 1; Watson, E. B., 1; Watt, D. A., 1; West, C. R., 1; Weston, R. S., 1; Weyer, A. E., 1; Whipple, W., Jr., 1; White, D. E., 1; Williams, R., 1; Winslow, E. E., 1; Wisner, G. Y., 2; Woermann, J. W., 1; Wood, B. A., 1; Woodward,

Lower Mississippi River basin--Continued.

C. M., 1; Woodward, S. M., 1; Young, S. M., 1; Anonymous, 14, 20, 22, 23, 31, 37, 38, 40, 52, 63, 93, 108, 109, 110, 111, 113, 114, 115, 116, 118, 146, 159, 167

Lower Red River basin

Bennett, H. H., 6; Bloodgood, D. W., 1, 6, 7, 8, 9, 10, 11, 12; Bradford, W., 1; Brown, C. B., 5, 7; Campbell, F. B., 2; Chester, C. P., 1; Clarke, F. W., 1, 2; Coker, R. E., 1; Dole, R. B., 2, 3; Eakin, H. M., 9; Featherstonhaugh, G. W., 1; Glymph, L. M., Jr., 6; Hall, L. S., 1; Hoag, W. R., 1; Holmes, R. S., 2; Jones, V. N., 1; Kerr, F. M., 1; Mead, D. W., 4; Oakes, H., 1; Ockerson, J. A., 1; Parsons, H. F., 1; Piper, A. M., 2; Texas, Board of Water Engineers, 4, 7, 8; Tiffany, J. B., Jr., 1; Townsend, C. M., 2; U. S. Engineer Dept., 18, 19, 86; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2; U. S. Waterways Experiment Station, Vicksburg, Miss., 1, 4; Veatch, A. C., 1; Vernon, R. C., 1; Anonymous, 111, 114, 145

Neosho-Verdigris River basins

Beckman, H. C., 1; Clarke, F. W., 1, 2; Dole, R. B., 8; Eakin, H. M., 9; Hall, L. S., 1; Holmes, R. S., 2; Kesler, T. L., 1; Parker, H. N., 1; Smyth, B. B., 1; Stevens, J. C., 2; U. S. Engineer Dept., 83; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2; U. S. Waterways Experiment Station, Vicksburg, Miss., 4; Anonymous, 111

Quachita River basin

Holmes, R. S., 2; Stevens, J. C., 2; U. S. Engineer Dept., 22; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2; U. S. Waterways Experiment Station, Vicksburg, Miss., 4; Vernon, R. O., 1; Anonymous, 111

Upper Arkansas River basin

Bates, C. G., 1; Bryan, K., 4; Clarke, F. W., 1, 2; Dana, S. T., 1; Duce, J. T., 1; Elliot, S. F., 1; Fortier, S., 2; Frye, J. C., 1; Happ, S. C., 9; Headen, W. P., 1; Holmes, R. S., 2; Humphrey, J. S., 1; Lane, E. W., 8; Mead, J. R., 1; Parker, H. N., 1; Parshall, R. L., 4; Rathbun, R., 1; Smith, H. T. U., 1, 2; Smyth, B. B., 1; Stevens, J. C., 2; Taylor, T. U., 6; U. S. Engineer Dept., 83, 86; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2; U. S. Forest Service, 2; Wilby, F. B., 1; Woolley, R. R., 2

Upper Red River basin

Bloodgood, D. W., 1, 5, 6, 7, 8, 9, 10, 11, 12; Brown, C. B., 1, 15; Eakin, H. M., 9; Evans, O. F., 1, 4; Faris, O. A., 1; Grover, N. C., 12; Harper, H. J., 1; Hemphill, R. G., 2; Hoag, W. R., 1; Johnston, C. T., 1; Munns, E. N., 4; Nagle, J. C., 1, 2, 3; Phillips, H., 1; Sonderegger, A. L., 2; Stabler, H., 3; Stevens, J. C., 2; Taylor, T. U., 6, 7; Texas, Board of Water Engineers, 2, 3, 5, 6, 9; U. S. Bureau of Reclamation, 2; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2; U. S. Waterways Experiment Station, Vicksburg, Miss., 4; Anonymous, 53, 57, 111

Washita River basin

Bennett, H. H., 6; Bollinger, C. J., 1; Brown, C. B., 7; Eakin, H. M., 9; Glymph, L. M., Jr., 9; Phillips, H., 1; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2; U. S. Waterways Experiment Station, Vicksburg, Miss., 4; Anonymous, 111

White-Black River basin

Beckman, H. C., 1; Bennett, H. H., 6; Brown, C. B., 5, 7; Collins, H. H., 1; Duley, F. L., 1; Eakin, H. M., 9; Hall, L. S., 1; Holmes, R. S., 2; Kesler, T. L., 2; Munns, E. N., 3; Stevens, J. C., 2; Towl, R. N., 8; U. S. Engineer Dept., 56; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2; U. S. Forest Service, 2; U. S. Waterways Experiment Station, Vicksburg, Miss., 1, 4; Anonymous, 111, 159

Yazoo-Big Black River basins

Bennett, H. H., 1, 6; Broughton, W. A., 1; Brown, C. B., 7, 8, 11; Eads, J. B., 7; Eakin, H. M., 6; Happ, S. C., 1, 2, 3, 5, 6, 9; Jones, L. A., 1; Lowe, E. N., 1; Munns, E. N., 4; Ramser, C. E., 4, 6; Stevens, J. C., 2; Trullinger, R. W., 1; U. S. Dept. of Agriculture, 3, 9; U. S. Federal Inter-

RIVER BASINS - UNITED STATES--CONTINUED.

7 Lower Mississippi River basin--Continued.

Yazoo-Big Black River basins--Continued.

Agency River Basin Committee, Subcommittee on Sedimentation, 2; U. S. Waterways Experiment Station, Vicksburg, Miss., 1, 4; Anonymous, 111

8 Western Gulf of Mexico basins

Brazos River basin

Alldis, V. R., 1; Ashe, W. W., 2, 5; Barnes, G. A., 1; Bennett, H. H., 5, 6; Bloodgood, D. W., 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12; Breeding, S. D., 1; Clarke, F. W., 1, 2; Corthell, E. L., 2; Curry, W. H., 1; Dappert, J. W., 1; Dole, R. B., 2, 3; Eakin, H. M., 4, 9; Faris, O. A., 1; Garin, A. N., 4; Geib, 1, 2; Griffith, W. M., 2; Grover, N. C., 10; Gustafson, A. F., 2; Hall, L. S., 1; Harrold, L. L., 4; Haupt, L. M., 1; Hemphill, R. G., 1, 2; Hill, H. O., 1; Johnston, C. T., 1; Khosla, A. N., 2; Love, S. K., 1; Mead, D. W., 4; Melton, F. A., 1; Munns, E. N., 3; Nagle, J. C., 1, 2, 3, 4; Phillips, H., 1; Piper, A. M., 2; Poor, R. S., 1; Ramser, C. E., 9; Ray, C. N., 1; Sidwell, R., 3; Sonderegger, A. L., 2; Stevens, J. C., 2; Taylor, T. U., 6; Texas, Board of Water Engineers, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13; Texas Planning Board, 1; U. S. Engineer Dept., 54, 57, 81, 83, 86; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2; U. S. Forest Service, 2; U. S. Office of Land Use Coordination, 1; U. S. Soil Conservation Service, 9; Wisner, G. Y., 1, 2; Anonymous, 53, 136

Colorado (of Texas) River basin

Ashe, W. W., 4, 5; Bennett, H. H., 6; Bloodgood, D. W., 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12; Breeding, S. D., 1; Brown, C. B., 1; Chance, H. M., 1; Clarke, F. W., 1, 2; Cleary, J. B., 1; Dappert, J. W., 1; Dole, R. B., 2, 3; Eakin, H. M., 9; Faris, O. A., 1; Flinn, A. D., 1; Gillette, H. P., 1; Griggs, R. F., 1; Gustafson, A. F., 2; Hall, L. S., 1; Hawley, J. B., 1; Hemphill, R. G., 2; Hinckley, H. V., 1; Khosla, A. N., 2; Labelle, H. F., 1; Mead, D. W., 3, 4; Moore, H. F., 3; Morgan, A. E., 2; Munns, E. N., 3, 4; Nagle, J. C., 4; Parker, P. A. M., 1; Phillips, H., 1; Robinson, H. F., 1; Schuyler, J. D., 4, 5; Sidwell, R., 1; Simonds, F. W., 1, 2; Sonderegger, A. L., 2; Stevens, J. C., 2, 5; Taylor, T. U., 1, 2, 3, 4, 5, 6, 7; Texas Board of Water Engineers, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13; Texas Planning Board, 1; Turneure, F. E., 1; Udden, J. A., 2; U. S. Engineer Dept., 31, 32, 54, 57, 81, 83, 86; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2; U. S. Forest Service, 2; U. S. Soil Erosion Service, 1; Weeks, A. W., 1; Wilby, F. B., 1; Anonymous, 39, 53, 70, 95

Guadalupe River basin

Bloodgood, D. W., 1, 5, 6, 7, 8, 9, 10, 11, 12; Brown, C. B., 1; Clarke, F. W., 1; Cleary, J. B., 1; Coghlan, R. R., 1; Eakin, H. M., 9; Faris, O. A., 1; Grover, N. C., 12; Hemphill, R. G., 2; Khosla, A. N., 2; Sonderegger, A. L., 2; Stevens, J. C., 2; Taylor, T. U., 6, 7; Texas Board of Water Engineers, 2, 3, 4, 5, 6, 8, 9; U. S. Engineer Dept., 55; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2

Lower Rio Grande (below Pecos River) basin

Bloodgood, D. W., 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12; Clarke, F. W., 1, 2; Curd, W. C., 1; Dole, R. B., 2, 3; Faris, O. A., 1; Finch, H. A., 1; Follett, W. W., 3; International Boundary and Water Commission, United States and Mexico, 1, 2, 3; International Boundary Commission, United States and Mexico, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15; Melton, F. A., 1; Stevens, J. C., 2; Taylor, T. U., 6, 7; Texas Board of Water Engineers, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2

Lower Rio Grande (Big Bend Section) basin

Brown, C. B., 23; Clarke, F. W., 1; Faris, O. A., 1; Follett, W. W., 3; Harrington, H. H., 1; International Boundary and Water Commission, United States and Mexico, 1, 2, 3; International Boundary Commission, United States and Mexico, 2, 3, 8, 15; Lawson, L. M., 5, 9; Melton, F. A., 1; Scofield, C. S., 1; Sonderegger, A. L., 2; Stevens, J. C., 2; Udden, J. A., 2; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2; Winsor, G. Y., 2

Middle Rio Grande basin

Alldis, V. R., 1; Arroyo, S., 1; Bailey, R. W., 3; Baker, D. M., 1; Bennett, H. H., 1, 5, 6; Bissell, C. A., 1; Black, R. F., 1; Brown, C. B., 1, 5, 7, 8; Bryan, K., 4, 5, 7, 8, 11, 12; Campbell, J. L., 1; Chapline, W. R., 2; Clarke, F. W., 1, 2; Cleary, J. B., 1; Coghlan, R. R., 1; Collins, H. H., 1; Cooperrider, C. K., 1, 2; Dappert, J. W., 1; Davis, A. P., 6, 8, 9; Davis, R. O. E., 2; De Boer, S. R., 1; Dole, R. B., 2; Duley, F. L., 1; Eakin, H. M., 3, 4, 9; Eaton, H. N., 2, 3; Edgcombe, A. R. B., 1; Ellis, M. M., 8; Faris, O. A., 1; Fiock, L. R., 1; Flinn, A. D., 1; Follansbee, R., 1; Follett, W. W., 2, 3; Fortier, S., 3; Gorrie, R. M., 1; Goss, A., 1; Granger, C. W., 1; Grover, N. C., 12; Grunsky, C. E., 5; Gustafson, A. F., 2; Hall, L. S., 1; Happ, S. C., 9, 14, 18; Harrington, H. H., 1; Hemphill, R. G., 2; Henny, D. C., 1; Hill, L. C., 1; Hill, R. A., 1; Houk, I. E., 4, 5; Hughes, D. E., 1; International Boundary and Water Commission, United States and Mexico, 1, 2, 3; International Boundary Commission, United States and Mexico, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15; Johnson, J. W., 4; Johnston, C. T., 1; Kellog, C. W., Jr., 1; Khosla, A. N., 2; Kotok, E. I., 1; Kriehbaum, H., 1; Kuenen, P. H., 2; Lane, E. W., 3, 4, 14, 24; Lawson, L. M., 3, 4, 5, 6, 7, 8, 9; Lee, W. T., 1; Malhotra, J. K., 1; Mavis, F. T., 2; Mead, E., 2; Mills, A., 1; Morgan, A. E., 1; Munns, E. N., 3; Murphy, E. C., 5; Nagle, J. C., 1, 2, 3, 4; Newell, F. H., 8; Peck, A. S., 1; Phillips, H., 1; Poor, R. S., 1; Powell, J. W., 3; Pyritz, H. W., 2; Pyle, F. D., 1; Read, W. M., 1; Rich, J. L., 1; Rittenhouse, G., 9, 14, 16; Robinson, H. F., 1; Rothery, S. L., 4; Rowalt, E. M., 1; Seavy, L. M., 4; Schuyler, J. D., 5; Schwennessen, A. T., 1; Scofield, C. S., 2; Seigfried, J. H., 1; Silcox, F. A., 1; Sonderegger, A. L., 2; Stabler, H., 3, 4; Stallings, J. H., 1; Stevens, J. C., 2, 4, 5, 6; Tarr, R. S., 1; Taylor, T. U., 6, 7; Turley, J., 1; U. S. Engineer Dept., 25, 54, 81, 86; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2; U. S. Forest Service, 2; U. S. Office of Land Use Coordination, 1; U. S. Soil Erosion Service, 1; Wilby, F. B., 1; Wilson, H. M., 3; Winsor, L. M., 4; Anonymous, 53, 60, 68, 162

Neches River basin

Bloodgood, D. W., 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12; Stallings, J. H., 1; Stevens, J. C., 2; Texas Board of Water Engineers, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2; Word, O. C., Jr., 1

Nueces River basin

Bloodgood, D. W., 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12; Brown, C. B., 35; Faris, O. A., 1; Stevens, J. C., 2; Texas Board of Water Engineers, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2

Pecos River basin

Bailey, R. W., 3; Bennett, H. H., 5, 6; Brown, C. B., 23; Bryan, K., 12; Chittenden, H. M., 1; Clarke, F. W., 1, 2; Davidson, W. C., 1; Davis, A. P., 6; Dole, R. B., 2; Eakin, H. M., 9; Edgcombe, A. R. B., 1; Fisher, C. A., 1; Follansbee, R., 1; Goss, A., 1; Gustafson, A. F., 2; Hall, L. S., 1; Harrington, H. H., 1; Hemphill, R. G., 2; International Boundary and Water Commission, United States and Mexico, 1, 2, 3; International Boundary Commission, United States and Mexico, 15; Johnston, C. T., 1; Khosla, A. N., 2; Kirkbridge, W. H., 1; Legget, R. F., 1; Leighton, M. O., 1; Means, T. H., 1; Meinzer, O. E., 1, 3; Nagle, J. C., 3; Newell, F. H., 8; Nielson, C. J., 1; Reed, W. M., 1, 2; Robinson, H. F., 1; Rowalt, E. M., 2; Sidwell, R., 4; Sonderegger, A. L., 2; Stabler, H., 3; Stevens, J. C., 2, 5; Taylor, T. U., 6, 7; U. S. Engineer Dept., 86; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2; U. S. National Resources Planning Board, 1; Wilby, F. B., 1; Anonymous, 70, 95

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8 Western Gulf of Mexico basins--Continued.

Sabine River basin

Bloodgood, D. W., 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12; Eakin, H. M., 9; Texas Board of Water Engineers, 6, 7, 8, 9; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2; Word, O. C., Jr., 1

Trinity River basin

Alldis, V. R., 1; Barnes, G. A., 1; Bennett, H. H., 5, 6; Bloodgood, D. W., 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12; Brown, C. B., 5, 7, 8, 15, 16; Bryan, K., 12; Classen, A. G., 1; Cleary, J. B., 1; Eakin, H. M., 9; Ellis, M. M., 4; Faris, O. A., 1; Garin, A. N., 2; Griffith, W. M., 2; Grover, N. C., 12; Gustafson, A. F., 2; Hall, L. S., 1; Hawley, J. B., 1; Hemphill, R. G., 2; Khosla, A. N., 2; Marshall, R. M., 1; Sonderegger, A. L., 2; Stevens, J. C., 2; Taylor, T. U., 6, 7; Texas Board of Water Engineers, 2, 3, 7, 8, 9, 10, 11, 12, 13; U. S. Dept. of Agriculture, 4; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2; Wilby, F. B., 1

Upper Rio Grande basin

Bates, C. G., 1, 2; Chapman, H. H., 4; Clarke, F. W., 1; Cooperrider, C. K., 2; Fiock, L. R., 1; Follett, W. W., 3; Newell, F. H., 1, 2; Scofield, C. S., 2; Stafford, H. M., 1; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2

Western Gulf basins

Ashe, W. W., 2, 5; Bloodgood, D. W., 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12; Breeding, S. D., 1; Bullard, F. M., 1; Collins, H. H., 1; Haupt, L. M., 1; Moore, H. F., 3; Ripley, H. C., 1; Texas Planning Board, 1; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2; U. S. Waterways Experiment Station, Vicksburg, Miss., 19; Watt, D. A., 1

9 Colorado River basin

Gila River basin

Alldis, V. R., 1; Ashe, W. W., 5; Bailey, R. W., 3; Baker, S. K., 1; Barrell, J., 1; Barrows, H. H., 2; Bates, C. G., 1; Bennett, H. H., 5, 6; Bowman, I., 2; Breazeale, J. F., 1; Brown, C. B., 5, 7, 8, 23; Bryan, K., 1, 3, 4, 7, 8, 12, 17; Chapline, W. R., 1, 2; Clarke, F. W., 1, 2; Collingwood, C. B., 2; Collingwood, F., 1; Cory, H. T., 2; Dappert, J. W., 1; Davis, A. P., 1, 2, 4, 5, 9, 11; Dole, R. B., 2; Duley, F. L., 1; Eakin, H. M., 4, 9; Eaton, H. N., 2; Edgecombe, A. R. B., 1; Etcheverry, B. A., 1; Fleming, B. P., 1, 2; Forbes, R. H., 1, 2, 3, 4; Fortier, S., 3; Gapen, K. M., 1; Gillespie, C. G., 1; Griffith, W. M., 2; Grover, N. C., 12; Grunsky, C. E., 5; Gustafson, A. F., 2; Harper, H. J., 1; Harris, A. L., 1; Hemphill, R. G., 2; Herion, G. A., 1; Hill, L. C., 1; Holmes, G. J., 1; Holmquist, F. N., 1; Howard, C. S., 1, 2; Hughes, D. E., 1; Johnston, C. T., 1; Khosla, A. N., 2; La Rue, E. C., 1, 3; Lawson, L. M., 2; Leighton, M. O., 1; Leopold, A., 1; Lippincott, J. B., 1; McGee, W. J., 2; McGeorge, W. T., 1; Matthes, G. H., 3; Mead, D. W., 6; Meinzer, O. E., 2; Munns, E. N., 3, 4; Murphy, E. C., 5; Nagle, J. C., 1; Newell, F. H., 3, 5; Olmstead, F. H., 1; Parker, J. D., 1; Peck, A. S., 1; Poor, R. S., 1; Pyeritz, H. W., 1; Pyle, F. D., 1; Robinson, H. F., 1; Ross, C. P., 1; Schoklitsch, A., 4; Schwennesen, A. T., 1; Smith, G. E. P., 1, 2, 3; Sonderegger, A. L., 2; Stabler, H., 3; Stevens, J. C., 2; Swift, T. T., 1; Sykes, G., 2; Taylor, T. U., 6; Tolman, C. F., 1; U. S. Congress, Senate, Committee on Irrigation and Reclamation, 1; U. S. Engineer Dept., 25, 57, 81; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2; U. S. Forest Service, 2; U. S. Reclamation Service, 1; Washington, W. de H., 1; Wilson, H. M., 3; Winn, F., 1; Woolsey, T. S., Jr., 1; Anonymous, 42, 70, 107, 136, 157

Green River basin

Buhler, E. O., 1; Clarke, F. W., 1; Cory, H. T., 2; Davis, A. P., 11; Dole, R. B., 2; Howard, C. S., 4, 5; Hoyt, W. G., 1; La Rue, E. C., 1; Lytel, J. L., 1, 2; Moore, R. C., 1; Sonderegger, A. L., 2; Stabler, H., 3; Stevens, J. C., 2; Sykes, G., 2; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2; Woolley, R. R., 1

Lower Colorado River basin

All-American Canal Board, 1; Alldis, V. R., 1; Allison, J. C., 1, 3; Ashe, W. W., 5; Bailey, R. W., 3; Baker, D. M., 1; Baker, S. K., 1; Barnes, F. J., 1; Bell, H. S., 1, 3, 4; Benedict, P. C., 1; Bennett, H. H., 5, 6; Berkey, C. P., 1; Blanchard, C. J., 1; Blanke, J. H. D., 1; Bowden, N. W., 2; Branch, L. V., 1; Breazeale, J. F., 1; Brown, C. B., 1, 17, 23; Brown, R. M., 3; Bryan, K., 4, 10, 12, 13; Carter, O. C. S., 1; Chapline, W. R., 2; Christiansen, J. E., 2; Clapp, W. B., 2; Clarke, F. W., 1, 2; Cleary, J. B., 1; Collingwood, C. B., 1, 2; Collins, W. D., 3, 4, 5, 7, 9, 10; Cooke, M. L., 1; Corfittzen, W. E., 1, 2, 3, 4, 6, 7; Cory, H. T., 2; Daines, N. H., 1; Dappert, J. W., 1; Davis, A. P., 10, 11, 12; Davis, R. W., 1; Dole, R. B., 2; Dowd, M. J., 1, 2, 3; Duley, F. L., 1; Durand, W. F., 1; Dutton, C. E., 1; Eakin, H. M., 3, 9; Eaton, H. N., 2, 3; Ebner, G., 2; Edholm, C. L., 1; Eliassen, S., 2; Entenman, P. M., 1; Etcheverry, B. A., 2; Faris, O. A., 1; Finkle, F. C., 1; Fiock, L. R., 1; Flinn, A. D., 1; Forbes, R. H., 2, 3, 4; Forester, D. M., 1, 2, 3, 4; Fortier, S., 2, 3; Foster, L. J., 1; Freeman, J. R., 3; Gilbert, G. K., 1, 3; Gillespie, C. G., 1; Gregory, H. E., 4; Griffith, W. M., 2; Grover, N. C., 2, 12; Grunsky, C. E., 1, 2, 3, 4, 5; Gulling, P., 1; Gustafson, A. F., 2; Haas, W. H., 1; Hall, L. S., 1; Harper, H. J., 1; Harris, I. C., 1, 2; Harrold, L. L., 1; Hemphill, R. G., 2; Henny, D. C., 1; Holland, C. E., 1; Holmes, G. J., 1; Holmquist, F. N., 1; Howard, C. S., 1, 2, 3, 4, 5, 7; Jacobs, J., 1; Johnson, J. W., 4; Jones, D. M., 1; Kelly, W., 1; Khanna, R. K., 5; Khosla, A. N., 2; Kidder, A. W., 1; Kniffen, F. B., 1; Koelzer, V. A., 1; Kriehbaum, H., 1; Kuenen, P. H., 2; Lane, E. W., 3, 4, 14, 23; Larsen, H. T., 1; La Rue, E. C., 1, 2, 3; Lawson, L. M., 1, 5; Leggett, R. F., 1; Leighly, J., 2, 4; Lippincott, J. B., 2, 3, 4; Love, S. K., 1, 2, 4; McGeorge, W. T., 1; McKee, E. D., 1, 2; McLaughlin, W. W., 1, 2; Matthes, G. H., 3; Mavis, F. T., 2; Maxson, J. H., 1, 2; Mead, D. W., 5, 6; Mead, E., 5, 6; Mead, T. C., 1; Melton, F. A., 1; Moore, R. C., 1; Morgan, A. E., 2; Morris, S. B., 1, 3; Munns, E. N., 3, 4; Murata, K. J., 1; Murphy, E. C., 2; National Research Council, Interdivisional Committee on Density Currents, Subcommittee on Lake Mead, 1, 2, 3; Newberry, J. S., 1; Newell, F. H., 5, 6, 7; Parker, T. C., 1; Parkinson, D., 1; Peck, A. S., 1; Phillips, H., 1; Piper, A. M., 2; Pyeritz, H. W., 1; Reagan, A. B., 3; Red Cross, U. S. American National Red Cross, Board of Engineers, 2; Richardson, F. H., 1; Robertson, L. E., 1; Robinson, H. F., 1; Rothery, S. L., 1, 2, 3, 4; Rowalt, E. M., 2; Savage, J. L., 1; Saville, T., 5; Schobinger, G., 1; Seigfried, J. H., 1; Sellow, F. L., 1; Shulits, S., 4, 6; Sibert, W. J., 1; Skerrett, R. G., 1; Smith, G. E. P., 2; Smith, W. D., 1; Sonderegger, A. L., 2; Stabler, H., 3, 5; Stanley, J. W., 1, 2, 3, 4, 5; Stevens, J. C., 2, 4, 5, 6; Sykes, G., 1, 2, 3, 4; Sykes, G. G., 1, 2; Taylor, E. M., 1; Taylor, T. U., 6, 7; Thone, F., 1; Thornthwaite, C. W., 1; Todd, O. J., 10; Towl, R. N., 6; Turneure, F. E., 1; U. S. Bureau of Reclamation, 3; U. S. Bureau of Reclamation, Office of River Control, Region III, 1, 2; U. S. Congress, Senate, Committee on Irrigation and Reclamation, 1; U. S. Engineer Dept., 25, 54, 57, 81, 83; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2; U. S. Reclamation Service, 1; Vetter, C. P., 1, 2, 3; Washington, W. D. H., 1; Weymouth, F. E., 1; Wilby, F. B., 1; Willey, D. A., 4; Wilson, H. M., 3; Wright, C. A., 1; Young, W. R., 2, 3, 4; Anonymous, 53, 61, 62, 63, 70, 76, 90, 91, 95, 104, 105, 107, 123, 134, 147, 148, 162, 163, 165, 180

San Juan River basin

Agar, W. M., 1; Bailey, R. W., 3; Baker, D. M., 1; Baker, S. K., 1; Bennett, H. H., 6; Breazeale, J. F., 1; Bryan, K., 4, 6, 9, 17; Chapman, H. H., 4; Clarke, F. W., 1; Cooperrider, C. K., 2; Cory, H. T., 2; Davis, A. P., 11; Dobbin, C. E., 1; Duce, J. T., 1; Fortier, S., 3; Gardner, J. L., 1; Gregory, H. E., 3, 5; Grover, N. C., 1; Harrold, L. L., 1, 2; Howard, C. S., 1, 3, 4, 5; Howe, E., 1; Hubbell, D. S., 1; Lane, E. W., 14; La Rue, E. C., 2; Leggett, R. F., 1; Miser, H. D., 1, 2, 3; Moore, R. C., 1; Pierce, R. C., 1; Reagan, A. B.,

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San Juan River basin--Continued.

2, 3; Rowalt, E. M., 2; Sonderegger, A. L., 2; Stabler, H., 3, 5; Stevens, J. C., 2; Sykes, G., 2; U. S. Congress, Senate, Committee on Irrigation and Reclamation, 1; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2; Williams, G. O., 1; Anonymous, 107

Upper Colorado River basin

Bailey, R. W., 3; Breazeale, J. F., 1; Brown, C. B., 17; Bryan, K., 13; Chapman, H. H., 4; Davis, A. P., 11; Follansbee, R., 2; Fortier, S., 3; Gilbert, G. K., 2, 3; Howard, C. S., 4, 5; La Rue, E. C., 1; Lazear, R. W., 1; Miner, J. H., 1; Moore, R. C., 1; Newberry, J. S., 1; Sonderegger, A. L., 2; Stabler, H., 3, 5; Stevens, J. C., 2; Sykes, G., 2; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2

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Central Great Basin

Brown, C. B., 20; Meinzer, O. E., 4; Sonderegger, A. L., 2; Van Winkle, W., 1

Great Salt Lake basin

Alter, J. C., 1; Bailey, R. W., 1, 2, 3; Barnes, W. C., 1; Buhler, E. O., 1; Chapline, W. R., 2; Clarke, F. W., 1; Corfitzen, W. E., 5; Forsling, C. L., 1; Gilbert, G. K., 7; Grover, N. C., 12; Happ, S. C., 9; Lynch, H. B., 1; Munns, E. N., 3; Pack, F. J., 1; Rowalt, E. M., 1; Sampson, A. W., 1; Schaub, E., 1; Silcox, F. A., 1; Sonderegger, A. L., 2; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2; Utah Special Flood Commission, 1; Winsor, L. M., 1, 4; Woolley, R. R., 2; Anonymous, 72

Humbolt River basin

Clarke, F. W., 1; Meinzer, O. E., 4

Northern Great Basin

Clarke, F. W., 1; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2; Van Winkle, W., 2

Sierra Nevada basin

Clarke, F. W., 1; Sonderegger, A. L., 2; Stabler, H., 3; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2; Van Winkle, W., 1

Yuma basin

Allison, J. C., 1, 2, 3; Breazeale, J. F., 1; Christiansen, J. E., 2; Clapp, W. B., 2; Clarke, F. W., 1; Collingwood, C. B., 2; Cory, H. T., 1, 2; Cramer, L. E., 1; Davis, A. P., 10, 12; Dowd, M. J., 1, 2, 3; Ebner, G., 2; Entenman, P. M., 1; Finkle, F. C., 1; Follett, W. W., 2; Forbes, R. H., 2; Forester, D. M., 3, 4; Fortier, S., 1, 2, 3; Foster, L. J., 1; Freeman, J. R., 2; Gillespie, C. G., 1; Griffith, W. M., 2; Grunsky, C. E., 1, 2, 3, 4, 5; Gulling, P., 1; Kelly, W., 1; Khanna, R. K., 5; Kidder, A. W., 1; Kniffen, F. B., 1; Lane, E. W., 4; Lawson, L. M., 1; McKee, E. D., 2; Mead, D. W., 6; Mead, E., 4; Piper, A. M., 2; Pyle, F. D., 1; Robertson, L. E., 1; Rothery, S. L., 1, 2, 4; Schobinger, G., 1; Shultis, S., 6; Sibert, W. J., 1; Skerrett, R. G., 1; Smith, W. D., 1; Sonderegger, A. L., 2; Stevens, J. C., 2, 5; Sykes, G., 2; Sykes, G. G., 1; Tait, C. E., 1; Taylor, E. M., 1; Tolman, C. F., 1; Towl, R. N., 6; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2; Van Winkle, W., 1; Washington, W. de H., 1; Weymouth, F. E., 1; Willey, D. A., 2; Anonymous, 58, 101

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Central California Coast basins

Allardis, V. R., 1; Bennett, H. H., 5, 6; Brown, C. B., 5, 7; Clarke, F. W., 1, 2; Eakin, H. M., 3, 9; Einstein, H. A., 10; Gorrie, R. M., 1; Grover, N. C., 12; Hall, L. S., 1; Khosla, A. N., 2; Kotok, E. I., 1; Morris, S. B., 1; Munns, E. N., 3; Stevens, J. C., 2; U. S. Dept. of Agriculture, 10; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2; U. S. Office of Land Use Coordination, 1; Van Winkle, W., 1

Northern California - Klamath basins

Brown, C. B., 18; Chase, A. W., 1; Clarke, F. W., 1, 2; Comstock, E. F., 1; Gustafson, A. F., 2; Harts, W. W., 2; Smith, O. R., 1; Stabler, H., 3; Swartley, A. M., 1; Tilton, G. A., Jr., 1; U. S. Engineer Dept., 61, 64; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2; Van Winkle, W., 1, 2

Sacramento River basin

Agar, W. M., 1; Ashe, W. W., 2, 4, 5; Bailey, P., 1; Bennett, H. H., 4; Bowen, E., 1; Bowie, A. J., 1; Brown, C. B., 31; Bryan, K., 2; California Debris Commission, 1, 2; California, Dept. of Engineering, 1, 2, 4; California, Dept. of Public Works, Division of Engineering and Irrigation, 1; California, Hydraulic Mining Commission, 1; California, Office of State Engineer, 1; Clapp, W. B., 1; Clarke, F. W., 1, 2; Dole, R. B., 2; Faries, C. W., 1; Foote, A. D., 2; Fox, S. W., 1; Freeman, F. R., 2; Gault, H. J., 1; Gilbert, G. K., 8, 10; Gillespie, C. G., 1; Goodrich, R. D., 1; Grunsky, C. E., 5, 6; Gustafson, A. F., 2; Hall, L. S., 1; Hall, W. H., 1, 2; Hammett, W. C., 1; Happ, S. C., 9; Harts, W. W., 1, 2, 3; Hilgard, E. W., 3; Hinds, N. E. A., 1; Hyatt, E., 1; Lane, E. W., 3; Leighly, J. B., 1; Manson, M., 1, 2; Maxwell, G. H., 1; Munns, E. N., 3; Newell, F. H., 3; Palmer, L. A., 1; Robertson, R. R., 1; Schuyler, J. D., 1; Smith, O. R., 1; Sonderegger, A. L., 2; Specht, G. J., 1; Stabler, H., 3; Stevens, J. C., 2; Stone, L., 1; Sumner, F. H., 2; Taylor, T. U., 7; Thomas, C. W., 1; Townsend, C. M., 2; U. S. Engineer Dept., 11, 15, 16, 27, 70, 90; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2; Van Winkle, W., 1; Waggoner, W. W., 1; Wilson, H. M., 2, 3; Young, W. R., 1; Anonymous, 13, 21, 43, 44, 56, 123, 153

San Francisco Bay basins

Bassell, B., 1; Bennett, H. H., 5, 7; Blanchard, F. B., 1; Bowen, E., 1; Brown, C. B., 7, 14; Clark, W. C., 1; Cooper, W. S., 1; Crafts, H. A., 2; Eakin, H. M., 9; Flinn, A. D., 1; Frank, B., 1; Fristoe, R. E., 1; Gilbert, G. K., 10; Grover, N. C., 12; Gustafson, A. F., 2; Hall, L. S., 1, 2; Hall, W. H., 1; Harts, W. W., 2; Hyatt, E., 1; Khosla, A. N., 2; Longwell, J. S., 1; Putman, J. A., 1; Reddick, H. E., 1; Sonderegger, A. L., 2; Sumner, F. B., 1; U. S. Engineer Dept., 15, 70; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2; Van Winkle, W., 1; Witzig, B. J., 1; Young, W. R., 1; Anonymous, 178

San Joaquin River basin

Andrews, E. C., 1; Bassell, B., 2; Bell, H. S., 5; Bennett, H. H., 6; Brown, C. B., 31; California Dept. of Engineering, 3; Chapline, W. R., 2; Chittenden, H. M., 1; Clarke, F. W., 1, 2; Dole, R. B., 2; Doolittle, H. L., 1; D'Rohan, W., 1; Eakin, H. M., 9; Flinn, A. D., 1; Foote, A. D., 2; Gilbert, G. K., 10; Grunsky, C. E., 3, 5; Hall, L. S., 1; Harts, W. W., 2, 3; Hinds, N. E. A., 1; Hyatt, E., 1; Khosla, A. N., 2; Legget, R. F., 1; Lippincott, J. B., 5; Melton, F. A., 1; Newell, F. H., 2; Pacific Coast Electrical Association, 1; Palmer, L. A., 1; Sonderegger, A. L., 2; Specht, G. J., 1; Stabler, H., 1, 3; Stearns, H. T., 1; Stevens, J. C., 2, 5; Thomas, C. W., 1; U. S. Engineer Dept., 15; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2; Van Winkle, W., 1; Watson, E. B., 1; Wilson, H. M., 2, 3; Young, W. R., 1; Anonymous 88, 89, 123

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American Society of Civil Engineers, Committee on Conservation of Water, 1; Anderson, H. W., 1; Bailey, R. W., 3; Barnes, F. F., 5; Bauman, P., 1, 2, 3, 4; Bell, H. S., 1; Bennett, H. H., 1, 3, 5, 6; Bermel, K. J., 1; Bowen, E., 1; Bradley, J. A., 1; Brown, C. B., 5, 7, 8; California, Dept. of Public Works, Division of Water Resources, 1; Chawner, W. D., 1; Clarke, F. W., 1, 2; Combs, T. C., 1; Conkling, Harold, 1; Conkling, Harris, 1; Cruise, R. E., 1; Dodge, B. H., 1; Dole, R. B., 2; Eakin, H. M., 3, 9; Eaton, E. C., 1; Einstein, H. A., 8; Fairbank, J. P., 1; Fisher, F. J., 1; Flinn, A. D., 1; Frank, B., 1; Gillette, H. P., 3; Grant, B. S., 1; Grover, N. C., 12; Grunsky, C. E., 3; Gustafson, A. F., 2; Hall, L. S., 1; Happ, S. C., 9; Hedberg, H. D., 1; Heinly, B. A., 1; Hoyt, W. G., 1; Irwin, G. M., 1; Kenyon, E. C., Jr., 1; Khosla, A. N., 2; Kinney, A., 1, 2; Kruckman, A., 2; Krumbein, W. C., 22, 27; Lane, D. A., 1; Laverty, F. B., 1; Los Angeles Co., Calif. Flood Control District, 1; Lukens, H. M., 1; Lynch, H. B., 1; McGlashan, H. D., 1; Marx, C. D., 1; Matthias, N. A., 1; Melton, F. A., 1; Mendenhall, W. C., 1; Morris, S. B., 2; Munns,

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11 Pacific Slope basins in California--Continued.

Southern California Coast basins--Continued.

E. N., 1, 2, 3, 4; Pasadena, Calif., Water Dept., 1; Pickels, G. W., 1; Piper, A. M., 2; Post, W. S., 1; Reagan, J. W., 1; Santa Barbara County Road Dept., 1; Schuyler, J. D., 1, 2, 3, 4, 5, 6; Silcox, F. A., 1; Sonderegger, A. L., 1, 2, 3; Sopp, C. W., 1; Springer, J. F., 1; Stallings, J. H., 1; Stevens, J. C., 2; Stewart, R. W., 1; Taylor, C. A., 1; Troxell, H. C., 1; U. S. Dept. of Agriculture, 2; U. S. Engineer Office, Los Angeles, Calif., 1; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2; U. S. Forest Service, 2; U. S. Office of Land Use Coordination, 1; U. S. Soil Conservation Service, 2; Van Winkle, W., 1; Wahlberg, H. E., 1; Watson, E. B., 1; Wilm, H. G., 1; Wilson, H. M., 3; Winsor, L. M., 1, 2, 3, 4; Wolff, J. E., 1; Anonymous, 25, 119, 131, 133, 155, 161, 172, 177, 182

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Clarke, F. W., 1, 2; Ellis, M. M., 7; Gottschalk, L. C., 3; Hough, J. L., 3; Khosla, A. N., 2; Mavis, F. T., 2; Scheffer, P. M., 1; Stabler, H., 3; Stevens, J. C., 1, 2; U. S. Engineer Dept., 47; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2; Van Winkle, W., 3; Warnock, J. E., 1; Anonymous, 81, 123

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Owyhee River basin

Clarke, F. W., 1, 2; Gottschalk, L. C., 5; Swartley, A. M., 1; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2; Van Winkle, W., 2

Salmon River basin

Gottschalk, L. C., 5; Munns, E. N., 3, 4; Stevens, J. C., 2

Upper Snake River basin

Adams, R. M., 1; Blackwelder, E., 1; Chapline, W. R., 2; Clarke, F. W., 2; Foote, A. D., 1; Fryxell, F. M., 1; Gorrie, R. M., 1; Gottschalk, L. C., 5; Jones, B. E., 1; Kotok, E. I., 1; Munns, E. N., 3; Newell, R. J., 1, 2; Peck, A. S., 1; Renner, F. G., 1; Stabler, H., 3; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2; Anonymous, 162

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Middle Columbia River basin

Clarke, F. W., 1, 2; Debler, E. B., 1; Eakin, H. M., 9; Gustafson, A. F., 2; Henny, D. C., 1; Khosla, A. N., 2; Russell, I. C., 1; Schilling, H. M., 1; Seigfried, J. H., 1; Stevens, J. C., 2, 5; Swaren, J. W., 1; Swartley, A. M., 1; U. S. Federal Inter-Agency River Basin Committee, Sub-

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Oregon Coast basin

Clarke, F. W., 1, 2; Edmondson, C. H., 1; Smith, O. R., 1; Swartley, A. M., 1; Thone, F., 2; U. S. Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation, 2; Van Winkle, W., 2; Ward, H. B., 1, 2; Watt, D. A., 1; Anonymous, 158

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Barnes, F. J., 1; Boughton, V. T., 1; Buckley, R. B., 4; Carpenter, L. G., 2; Davis, A. P., 1; Debler, E. B., 1; Faris, O. A., 1; Fortier, S., 1, 2; Foster, L. J., 1, 2; Johnston, C. T., 1; Ketchum, C. C., 1; Lawson, L. M., 4; Maignen, J. P. A., 1; Miner, J. H., 1; Stevens, R. B., 1; Williamson, T., 1; Anonymous, 29, 68, 124, 163

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Ayers, A. H., 1; Boughton, V. T., 1; Carpenter, L. G., 1; Horton, R. E., 1; Lane, D. A., 1; La Rue, E. C., 2; Patrashev, A. N., 1, 2; Reed, W. M., 1; Schuyler, J. D., 3; Sorzano, J. F., 1; Witzig, B. J., 1

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SHAPE OF PARTICLES. See **PARTICLES**

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MECHANICAL ANALYSIS OF SEDIMENT;
MINERALOGICAL ANALYSIS OF SEDIMENT

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Bank protection. See **BANK PROTECTION**

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Abbott, H. B., 1; Adams, F. D., 1; Allison, J. C., 2, 3, 4; Andrews, E. C., 1; Ashe, W. W., 2; Bagnall, G., 1; Barber, J. W., 1; Barnes, W. C., 1; Barrows, H. H., 1; Barton, A., 1; Beglar, J. D., 1; Bell, H. S., 1; Bennett, C. S., 1, 6; Beurle, C., 1; Blackford, W. W., 1; Bollinger, C. J., 1; Bowie, A. J., 1; Brooks, B., 1; Broughton, W. A., 1; Brown, C. B., 2, 9, Brown, L. W., 1, 2; Brown, R. M., 1, 2; Brune, G. M., 3; Bryan, K., 2, 3, 4, 16, 17; Buchanan, G. C., 1; Buckley, R. B., 2, 4; California, Dept. of Engineering, 1, 4; California, Office of State Engineer, 1; Campbell, M. R., 1; Carmen, J. E., 1; Chandra, A. L., 1, 2, 3; Chase, 1; Chittenden, H. M., 1; Clark, W. C., 1; Claxton, P., 2; Collie, G. L., 1; Cooley, L. E., 2; Cooperrider, C. K., 2; Corthell, E. L., 1; Cory, H. T., 2; Crowell, J. F., 1; Crugnola, G., 1; Dappert, J. W., 1; Davis, A. P., 10, 12; Dixey, F., 1; Driver, W. J., 1; Eads, J. B., 1, 2, 3, 7; Ellis, T. G., 1; Emmons, W. H., 1; Entenman, P. M., 1; Evans, O. F., 1, 2; Fisk, H. N., 1, 2, 3; Fontaine, E., 1; Fortier, S., 3; Fox, S. W., 1; Framji, K. K., 23; Freeman, J. R., 2; Glandotti, M., 1; Gilbert, G. K., 3, 10; Glangeaud, M. L., 1; Glenn, L. C., 1, 3; Gottschalk, L. C., 9; Gregory, H. E., 3; Grunsky, C. E., 1, 3, 5; Gulliver, F. P., 1; Gustafson, A. F., 2; Haas, W. H., 2; Hall, W. M., 1; Hanslow, H., 1; Happ, S. C., 1, 6, 8, 9, 13, 14, 17, 18; Harris, E. G., 1; Hathaway, G. A., 1; Haworth, E., 1; Hickson, R. E., 2; Hill, A., 1; Hjulström, F., 1; Hobbs, C. S., 1; Holmquist, F. N., 1; Humphreys, A. A., 1; Hyatt, E., 1; Inglis, W. A., 1; Interstate Commission on the Potomac River Basin, 1; Jaggar, T. A., Jr., 1; Joglekar, D. V., 1; Johnson, D., 1; Johnson, W. A., 1; Jones, V. H., 2, 11; Kelly, W., 1; Kemp, J. F., 1; Kesseli, J. E., 1; Kerr, F. M., 1; Khanna, R. K., 6; Kidwell, A. L., 1; Kindle, E. M., 5; Kniffen, F. B., 1; Krynine, P. D., 2; Kunsman, H. S., 1; Lacey, J. M., 2; Lane, E. W., 1, 24; Lassen, L., 1; Lawes, G. W., 1; Lawson, L. M., 3, 6; League of Nations, 1; Leavitt, S., 1; Leighly, J. B., 1; Lewis, A., 1; Lin, D. Y., 2; Littlefield, M., 1; Lobeck, A. K., 1; Login, T., 2; Lokhtine, V., 1; Longridge, J. A., 1; Lougee, R. J., 1; Lowdermilk, W. C., 3, 4, 5; Lowe, E. N., 1; Lugn, A. L., 2; McClintock, P., 1; McClure, D., 1; McGee, W. J., 1; McMath, R. E., 1, 4, 5; Majumdar, S. C., 1; Makin, J. H., 1, 2; Mather, W. W., 1; Maxwell, G. H., 1; Mead, D. W., 4, 6; Mead, E., 5; Mead, J. R., 1; Mill, H. R., 1; Miser, H. D., 1, 2; Moberly, C. H., 1, 2, 3, 4, 5, 6, 7, 8; Morison, G. W., 1; Munns, E. N., 3; Murphy, E. C., 2; Needham, J. G., 1; New York (State), Division of State Planning, 1; Newberry, J. S., 1; Ockerson, J. A., 4; Parkins, A. E., 2; Penck, 1; Pennsylvania State Planning Board, 1, 2, 3, 4, 5; Pennsylvania Water Supply Commission, 1, 2; Péwé, T. L., 1; Pierce, R. C., 1; Pyeritz, H. W., 2; Raeburn, C., 1; Reagan, A. B., 1, 3; Red Cross, U. S. American National Red Cross, Board of Engineers, 1, 2; Rehbock, T., 1; Reyer, A., 1; Richtofen, F. von, 1; Roberts, T. P., 2; Ross, C. P., 1; Rothery, S. L., 1, 4; Rowalt, E. M., 1; Rubey, W. W., 1, 4; Ruckman, J. N., 1, 2; Russell, R. J., 3, 4; Salisbury, E. F., 1; Sampson, H. C., 1; Schobinger, G., 1; Schull, C. A., 1; Shannon, C. W., 1; Shaw, A. M., 2; Shulits, S., 5; Sidwell, R., 1, 2, 3; Silliman, B., 1; Smith, G. E. P., 3; Smith, H. T. U., 1, 2; Smith, W. D., 1; Sonderegger, A. L., 1, 2; Starling, W., 6; Steinmayer, R. A., 1; Stevens, J. C., 2, 5; Stone, W. L., 1; Straub, L. G., 10; Stroebe, G. G., 1; Swenson, F. A., 1; Sykes, G., 2; Tarr, R. S., 2; Tennessee State Planning Commission, 1; Trowbridge, A. C., 3, 5; Turley, J., 1; Twenhofel, W. H., 3, 9; U. S. Engineer Dept., 4, 7, 8, 10, 15, 16, 21, 33, 36, 40, 44, 46, 66, 68, 69, 76, 80, 83, 84, 89; U. S. Mississippi Commission, 1, 2, 3, 8, 10;

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U. S. Office of Land Use Coordination, 1; Vernon, R. O., 1; Vernon-Harcourt, L. F., 1, 2, 6, 7; Wentworth, C. K., 10; Wheeler, W. H., 1; Whipple, W., Jr., 1; White, D. E., 1; Wilby, F. B., 1; Williams, G. O., 1; Wilson, J. D., 1; Winn, F., 1; Worthington, E., 1; Young, W. R., 1; Anonymous, 3, 8, 13, 16, 27

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Effect of alignment, cut-offs, hydraulic characteristics, velocity, slope, levees, and other factors

Barrell, J., 1; Brown, R. M., 2; Dixey, F., 1; Einstein, H. A., 6; Ferguson, H. B., 1, 2, 3; Framji, K. K., 17; Freeman, J. R., 2; Grantham, R. F., 2; Gregory, H. E., 3; Griffith, W. M., 1; Haas, W. H., 2; Hancock, R. T., 1; Harris, E. G., 1; Haworth, E., 1; Hershel, C., 1; Hooker, E. H., 1; Howard, D. S., 1, 2; Inglis, W. A., 1; Inman, D. L., 1; Jones, V. H., 11; Kesseli, J. E., 1; Khanna, R. K., 1, 2, 6; Krumbein, W. C., 10; Lane, E. W., 7; Leighly, J. B., 1; Login, T., 1, 2; Lokhtine, V., 1; Longwell, C. R., 1; McGee, W. J., 5; McMath, R. E., 4; Makin, J. H., 1, 2; Matthes, G. H., 2, 6; Mead, D. W., 4; Mead, J. R., 1; Morison, G. W., 1; Owens, J. S., 5; Patrashchev, A. N., 2; Poliakov, B. V., 2; Powell, J. W., 2; Rehbock, T., 1; Reynolds, O., 1; Roberts, T. P., 1, 2; Rubey, W. W., 1, 5; Ryves, R. A., 1; Salisbury, E. F., 1; Salisbury, R. D., 1; Schoklitsch, A., 5; Schull, C. A., 1; Seddon, J. A., 1; Sharpe, C. F. S., 1; Shulits, S., 5, 8; Smith, D. T., 1; Sonderegger, A. L., 1, 2; Spencer, J. E., 1; Stanley, J. W., 5; Starling, W., 3; Stevens, J. C., 4, 5; Switzerland, Amt für Wasserwirtschaft, 1; Tanner, W. F., 1; Thomas, A. R., 5; Todd, J. E., 1; Tolman, C. F., 1; Townsend, C. M., 1, 2; Trowbridge, A. C., 5; Twenhofel, W. H., 3, 9, 13; U. S. Mississippi River Commission, 10; U. S. Waterways Experiment Station, Vicksburg, Miss., 6; Van Der Veen, H., 3; Velikanov, M. A., 2; Vernon-Harcourt, L. F., 9; Welch, A., 1; Whipple, W., Jr., 1; Willis, B., 1; Winsor, L. M., 3, 4; Anonymous, 8, 15, 19, 23, 47

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Sand bars, shoals, and mud deposits

Blaauw, G., 1; Corthell, E. L., 1; Ellis, T. G., 1; Forshey, C. G., 2; Gilbert, G. K., 10; Glangeaud, M. L., 1; Glenn, L. C., 2; Guérard, A., 1; Häntzschel, W., 1; Harrison, J. T., 1; Haupt, L. M., 2, 5; Heindenstam, A. V. H. von, 1; Hickson, R. E., 2; Humphreys, A. A., 1; Johnson, J. B., 1; Kemble, F. A., 1; Kindle, E. M., 6; Kniffen, F. B., 1; Lawes, G. W., 1; Matthews, E. R., 2; Maxson, J. H., 2; Needham, J. G., 1; Ockerson, J. A., 4, 5; Parker, F. Y., 2; Pratt, J. M., 1; Rennie, J., 1; Ripley, H. C., 1; Roberts, M. W., 1, 2; Schulz, E. H., 4; Shamov, G. I., 3; Shell-shear, W., 1; Sherrill, C. O., 1, 2; Shields, W. H., 1; Starling, W., 6, 7; Tiffany, J. B., Jr., 1, 2; Townsend, C. M., 2, 3, 4; Tyler, M. C., 1; U. S. Engineer Dept., 14, 21, 24, 53, 92; U. S. Forest Service, 2; U. S. Mississippi River Commission, 10; U. S. Waterways Experiment Station, Vicksburg, Miss., 9, 19; Veatch, A. C., 1; Vernon-Harcourt, L. F., 6, 7; Vezzani, R., 1; Vogel, H. D., 3; Wall, E. E., 2; Washburn, A. E., 1; Wheeler, W. H., 2, 3, 4; Winslow, E. E., 1; Wisner, G. Y., 1; Anonymous, 2, 7, 14, 99

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Chiera, A., 1; Claxton, P., 9; Colyer, C. A., 1;

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Fisk, H. N., 3; Jakuschoff, P., 1; Kidwell, A. L., 1; Morris, B. T., 1; Murphy, E. C., 4; Oaks, R. M., 1; Punjab Irrigation Research Institute, Lahore, 5; Redway, J. W., 1; Townsend, C. M., 2; U. S. Engineer Dept., 80; Vanoni, V. A., 1, 3; Wright, C. A., 1; Anonymous, 46

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SUBSIDENCE OF SEDIMENT DEPOSITS. See MASS

PROPERTIES OF SEDIMENT DEPOSITS

SURFACE TEXTURE OF PARTICLES. See PARTICLES

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Barry, A. C., 1; Buckley, A. B., 1; Chatley, H., 5; Christiansen, J. E., 1, 2; Greene, D. M., 1; Hjulström, F., 1; Hooker, E. H., 1; Lane, E. W., 20; Mardles, E. W. J., 1; Matthes, G. H., 7

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Abbot, H. L., 1, 2; Barnes, F. J., 1; Bogardi, J., 2; Britt, R. H., 1; Brown, C. B., 23; Bruun, P., 1; Buckley, A. B., 1; Chang, Y. L., 1; Chatley, H., 2; Christiansen, J. E., 1, 2; Cunningham, A., 1; Daines, N. H., 1; Davis, R. F., 1; DeLapp, W., 1; Dobbins, W. E., 1; Dobson, G. C., 3; Dryden, H. L., 1; Eads, J. B., 4, 6; Eakin, H. M., 5; Elliott, D. O., 1; Forshey, C. G., 3; Frizell, J. P., 1; Frosini, P., 1; Frouhet, F., 1; Glandotti, M., 1; Gilbert, G. K., 3, 4, 7; Graubau, A. W., 1; Griffith, W. M., 1, 2; Guth, E., 1; Harrod, B. M., 1, 2; Haworth, E., 1; Hayami, S., 1, 2; Herschel, C., 1, 2; Hjulström, F., 1, 3; Hooker, E. H., 1; Hopkins, W., 1; Howard, C. S., 3, 5; Hsia, C. H., 1; Humphreys, A. A., 1; Hurst, H. E., 1; Inglis, C. C., 14, 27; Inman, D. L., 1; International Boundary Commission, United States and Mexico, 8; Jakuschoff, P., 1, 2; Jeffery, G. B., 1; Jeffreys, H., 1; Johnson, J. W., 3, 4; Kalinske, A. A., 1, 2, 3, 4, 5, 6, 8, 9, 10, 11; Kennedy, R. G., 1; Keulegan, G. H., 1; Kirkham, D., 1; Knapp, R. T., 2; Lacey, G., 5; Lane, E. W., 9, 12, 14, 23; Leighly, J. B., 1, 2, 3, 5; Levy, I. I., 1; Lin, D. Y., 2; Logan, T., 1; Login, T., 1, 2; Love, S. K., 1; Lugn, A. L., 2; McGee, W. J., 5; McMath, R. E., 3, 4, 6; Mann, I. J., 1; Matthes, G. H., 5; Mees, C. A., 1; Milne-Thompson, L. M., 1; Mitchell, B. T., 1; Morris, B. T., 1; Müntz, A., 2; Murphy, E. C., 3; Makayama, H., 1; Nemenyi, P., 2; Nevin, C., 1; O'Brien, M. P., 1, 4; Owens, J. S., 1, 2, 3, 4, 5; Parker, P. A. M., 1; Patrashchev, A. N., 2; Pickels, G. W., 1; Pien, C. L., 1; Powell, J. W., 2; Punjab Irrigation Research Institute, Lahore, 2; Quirke, T. T., 1; Quraishy, M. S., 2, 3; Ramser, C. E., 8; Richardson, E. G., 1, 2, 4, 6, 7; Rothery, S. L., 4; Rouse, H., 1, 3, 4, 5, 6, 7, 8, 9; Rubey, W. W., 4, 5, 6, 8; Schoklitsch, A., 4, 5; Shelford, W., 1; Slade, J. J., 1, 2; Sonderegger, A. L., 1; Stabler, H., 2; Starling, W., 3, 4; Straub, L. G., 1, 4, 6, 11, 12, 13; Switzerland, Amt für Wasserwirtschaft, 1, 2; Taylor, C. A., 2; Taylor, E. H., 1; Taylor, G. I., 1, 2; Tchen, C. M., 1; Thomas, A. R., 1; Townsend, C. M., 3; Twenhofel, W. H., 9; U. S. Engineer Dept., 80; U. S. Interdepartmental Committee, 8; U. S. Mississippi River Commission, 1; U. S. Waterways Experiment Station, Vicksburg, Miss., 1, 4, 20, 21; Van Driest, E. R., 2; Van Kárman, T., 1; Vanoni, V. A., 1, 2, 3, 4, 5; Velikanov, M. A., 2; Vetter, C. P., 2; Whipple, W., Jr., 1; White, A. M., 1; Wilson, W. E., 1; Winsor, L. M., 3, 4; Wisner, G. Y., 2; Anonymous, 11, 14, 23, 49, 98, 108

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Yangste River Commission, Technical Committee, 1, 2, 3; Clemson, T. G., 1; Collie, G. L., 1; David, T. W. E., 1; Davis, A. P., 3; Drouhet, F., 1; Eliassen, S., 1, 3, 6, 7; Ellis, W. M., 1; Elsdon, O., 1; Freeman, J. R., 2; Frosini, P., 1; Giandotti, M., 1, 3, 4, 5; Graubau, A. M., 1; Guérard, A., 1; Guppy, H. B., 1; Hill, A., 1; Hjulström, F., 1, 2, 3; Hsieh, C. T., 1; Hsu, S., 1; Humphreys, A. A., 1; Hurst, H. E., 3; Husband, J. W., 1; Indus River Commission, 2; Ingham, W., 1; Ionides, M. G., 2; Jakuschoff, P., 1; Joachim, A. W. R., 1; Joglekar, D. V., 1; Johnston, W. A., 1, 3; Kanthack, F. E., 2; Kao, C. Y., 2, 3; Kent, R. J., 1; Khosla, A. N., 2; King, L. C., 1; Lane, E. W., 1; League of Nations, 1; Lewis, A. D., 1; Login, T., 1; Longridge, J. A., 1; Lowdermilk, W. C., 1; McCrae, J., 1; Moberly, C. H., 3; Müntz, A., 1, 2; Nesper, F., 1; New South Wales, Water Conservation and Irrigation Commission, 1, 2, 4; Nikolitch, M., 1; Prestwich, J., 1; Saville, T., 3; Schaank, E. M. H., 1; Schoklitsch, A., 4; Sensidoni, F., 1; Shaw, A. M., 2, 3; Shelford, W., 1; Shenyi, 1; Simaika, Y. M., 1; South Africa, Drought Investigation Commission, 1; Spring, F. J. E., 1; Stevens, J. C., 2; Stiny, J., 1; Stroebe, G. G., 1, 2; Swain, G. F., 1; Tijmstra, S., 1; Todd, O. J., 1, 2, 3, 4, 8, 9, 10; Torrance, W., 1; Van Der Veen, H., 1, 3; Vanleer, B. R., 1; Vernon-Harcourt, L. F., 7; Vezzani, R., 1; Wallace, R. C., 1; Ward, E. T., 1; Warren, C. H., 1; Wilson, G., 1; Wilson, H. M., 4; Wong, W. H., 1; Yen, C. H., 1; Anonymous, 2, 6, 36, 55, 77, 78, 79, 96, 118, 150, 156, 164

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